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RESULTS OF THE PART-TASK SHIPHANDLING TRAINER PRE-PROTOTYPE TRAINING EFFECTIVENESS EVALUATION (TEE)

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The Part Task Trainer for Shiphandling (PARTT-SHIP) device represents one portion of the Naval Training Equipment Center's shiphandling research program. This device was functionally defined after conducting a Navy shiphandling task analysis, and developing a functional specification for a trainer to accomplish approximately 80 percent of the training objectives required for basic and intermediate level shiphandlers.

The PARTT-SHIP is a pre-prototype of a part-task shiphandling trainer. The pre-prototype is a low cost version that mimics the actual capabilities of a fully capable shiphandling part-task trainer. The goal of building a pre-prototype was to demonstrate and evaluate in several ways the capability of the actual device which could be built.

The quantitative portion of the PARTT-SHIP demonstration was recorded for Training Effectiveness Evaluation purposes. ~~The results are contained in this report.~~ Training was

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conducted in two areas of shiphandling skills, i.e., collision avoidance and maneuvering in restricted waters. Sixty-three students participated in these training experiments. Students were given pretests on a full bridge shiphandling trainer to establish their entry level skills in shiphandling. They were subsequently trained for one full day in assigned skill areas and then posttested, again on the full bridge device, to establish the training gain.

In both collision avoidance and restricted waters training, experimental results showed PARTT-SHIP to be an equally effective training device compared to a full bridge simulator. Results indicate a potential for PARTT-SHIP as part of a total shiphandling training system.

EXECUTIVE SUMMARY

INTRODUCTION

The PARTT-SHIP device (Figure A) represents one portion of the Naval Training Equipment Center's shiphandling research program. This device was functionally defined after conducting a Navy shiphandling task analysis, and developing a functional specification for a trainer to accomplish approximately 80 percent of the training objectives required for basic and intermediate level shiphandlers.

The PARTT-SHIP is a pre-prototype of a part-task shiphandling trainer. The pre-prototype is a low cost version that mimics the actual capabilities of a fully capable shiphandling part-task trainer. The goal of building a pre-prototype was to demonstrate and evaluate in several ways, the capability of the actual device which could be built.

Demonstration of these capabilities took place over the last half of 1983 during which a training effectiveness evaluation (TEE) was conducted. In addition to the empirical TEE, Navy officers from many different operational and school commands were asked to visit the trainer, witness and partake in a demonstration, and evaluate the pre-prototype in terms of their own shiphandling experience and background.

The quantitative portion of the PARTT-SHIP demonstration was recorded for TEE purposes. The results are contained in this report.

Training was conducted in two areas of shiphandling skills, i.e., collision avoidance and maneuvering in restricted waters. Sixty-three students from the Surface Warfare Officers School (Basic) participated in these training experiments. Students were given pretests on a full bridge shiphandling trainer to establish their entry level skills in shiphandling. They were subsequently trained for one full day in assigned skill areas and then posttested, again on the full bridge device, to establish the training gain.

COLLISION AVOIDANCE TRAINING

Collision avoidance exercises were conducted in open ocean areas and consisted of crossing situations exclusively. Students were required to collect and evaluate the necessary information to identify threats of collision, formulate decisions concerning the proper action to take, and then to implement that action. Performance was evaluated on the basis of the range at which they took their action and the final closest point of approach (CPA) to the traffic vessel of interest. The results showed that students who took appropriate action were able to significantly increase CPAs after training on only six to eight 20-minute exercises. However,

no significant increase was found in the number of students taking appropriate action. The interpretation of these results suggest that PARTT-SHIP was an effective trainer but that one training day was not sufficient to train all of the skills required for the problem solving and decision making strategies necessary to behave properly in collision avoidance situations. PARTT-SHIP was found to be an equally effective training device compared to a full bridge simulator for collision avoidance training.

RESTRICTED WATERS TRAINING

Other groups of Navy officers were trained in skills necessary for safe maneuvering in restricted waters. These groups were pretested to establish entry level skills, trained, and then posttested to determine the training gain for one day of training. Subjects were divided into several equal groups that trained on various versions of the PARTT-SHIP device. Each version had one major hardware subsystem (visual scene, situation display, computer assisted instruction) systematically eliminated in an attempt to isolate the unique effects of that subsystem on training.

Maneuvering in restricted waters was evaluated in terms of track keeping as measured by crosstrack distance (CRTD), and total distance traveled alongtrack (ALTD) in a given scenario. Crosstrack distance was measured from the center of channel, right or left, to the center of gravity of ownship. Alongtrack distance was measured from the starting point, along the actual track traveled, to the ending point. Ending points were determined by the instructor, and were caused by reaching the designed end of the scenario or by an excursion from the channel. It was found that crosstrack distance was a better measure for determining training gain between pretests and posttests, while alongtrack distance was a better measure of the differences between the various subsystems in contributing to training gain.

Results showed that there was substantial gain in the ability to stay on track in a difficult channel after PARTT-SHIP training. There were no differences between basic students trained on the complete PARTT-SHIP compared to basic students trained on the full bridge simulator. Only when the PARTT-SHIP trainer was used in a reduced configuration were the full bridge simulator trained groups better. Additionally, differences between groups for alongtrack distance traveled indicates that, when students were given both visual information in the computer generated scene and radar-like information on the plan position indicator (PPI)/situation display, they did less well than when given only one type of information. Students using visual scene information only (out-the-window) did as well as students given radar like information only on the PPI/situation display. This suggests that basic level shiphandlers are not capable of using these two sources of information simultaneously or are not experienced enough to determine which source of information is most reliable in varying conditions.

Combined results from these two experiments show PARTT-SHIP to be an effective, low cost alternative to the use of a full bridge simulator for basic shiphandling training. Results indicate a potential for PARTT-SHIP as part of a total shiphandling training system.

Future research is necessary to establish the generality of these results for more advanced shiphandlers and to investigate the effects of various training displays used during exercise run.

FOREWARD

This study is the first in a series of shiphandling studies conducted by/for the Human Factors Laboratory. These studies will concentrate on defining necessary parameters for surface and subsurface shiphandling training systems. These studies will examine part-task approaches for lowering shiphandling training costs and will explore the possibility of simulating unique Navy shiphandling tasks (e.g., mine laying and sweeping, underway replenishment, tactical shiphandling, etc.). The goal of these studies is to provide decision-makers with information about cost-effective shiphandling training alternatives so that basic, intermediate and advanced shiphandling trainees may receive instruction most appropriate for their operational needs. The Human Factors Laboratory wishes to express its appreciation to the officers of the Surface Warfare Officer School (Basic) in Newport, Rhode Island for their participation in this study. Special thanks is extended to Captain F. Zmorenski and Commander M. Weir for their cooperation.

Dee H. Andrews
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Section 1

INTRODUCTION

1.1 BACKGROUND

Development of a shiphandling training system has been the goal of the Naval Training Equipment Center (NAVTRAEQUIPCEN) to meet the training needs of the Navy at all levels. A portion of that system has been functionally described: a part-task shiphandling trainer (PARTT-SHIP) and a full bridge simulator. These devices stand apart from navigation and tactical trainers in that they are aimed only at the shiphandler and the shiphandling bridge team. A statement of the shiphandling trainer functional descriptions is contained in Hanley, Bertsche, and Hammell (1982) which describes the analyses and surveys that support the system configuration.

To support the concept of a part-task shiphandling training device, a pre-prototype of the device was built for NAVTRAEQUIPCEN for the purpose of conducting a training effectiveness evaluation (TEE) and to demonstrate the potential of the device to the Navy. A part-task trainer of this type has never been used for any kind of shiphandling training. The following sections describe the conduct and result of the TEE and a survey of Navy personnel who have used the device.

1.2 TEE CONCEPT

A plan was submitted to NAVTRAEQUIPCEN for a TEE of the PARTT-SHIP pre-prototype in May 1983. This plan was a proposal to conduct two technical experiments that would answer practical questions concerning the part task trainer with these goals:

a. Provide a rational (qualitative) and empirical (quantitative) evaluation of the PARTT-SHIP pre-prototype. This included two comparative experiments that examine the capabilities of the pre-prototype with those of a full bridge simulator. Subjects were to be junior naval officers who were novices in shiphandling. Two areas of shiphandling skill would be trained and tested: restricted waters maneuvering and collision avoidance decision making. Relative training effectiveness was the emphasis of these experiments.

b. Examine the contribution of major PARTT-SHIP subsystems to training effectiveness. This would aid in supporting engineering specifications of the device, and could be used in cost trade-off decisions in the future.

1.3 APPROACH

An experimental paradigm was chosen which used a pretest and posttest. Students would be screened for entry level minimum skills, pretested, trained, and then posttested. The change in

performance from beginning to end of training would serve as a predictor of how well the pre-prototype device could be expected to perform as part of a formal school setting.

TEEs usually take place in ongoing training settings but are confounded by many scheduling and training variables. The laboratory-like setting used for this TEE offered greater control over extraneous variables. Both the full bridge simulator and PARTT-SHIP pre-prototype were housed in the same building, where access for pretests and posttests would be maximized. Scenarios that were identical in all respects were used on both devices.

Figure 1-1 shows the relation of experimental and control groups to the two experiments planned. To gather as much information as possible in the time and resources available, a minimum group size of n=9 was selected. This resulted in a total of seven subject groups, N=63. Figures 1-2 and 1-3 shows the experimental sequences for control and experimental groups, respectively.

It was assumed that experimental and control groups would be directly compared on a series of pretests and posttests. Control groups would be pretested and posttested once. Experimental groups would be pretested once on the simulator and once on the PARTT-SHIP. They would then be trained and posttested on both the PARTT-SHIP and simulator. This would allow direct comparisons of beginning and ending skill levels on each device.

1.4 PREDICTED OUTCOMES

1.4.1 PARTT-SHIP VARIATIONS. It was hypothesized that the complete PARTT-SHIP, as designed, would yield the greatest training gain of the four PARTT-SHIP variations because of the plan position indicator (PPI) situation display, special training displays, and high resolution computer generated images (CGI). However, to find how much each subsystem contributed to that gain, several reduced versions of the pre-prototype were used. An assumption was made that anything less than the complete PARTT-SHIP design would result in degraded training as reflected on posttests. Benefits of this method would be knowledge about the magnitude of degraded performance respective to the removal of each subsystem that could later be used in cost tradeoff analyses.

No a prior predictions could be made about how the different reduced versions of the PARTT-SHIP would effect performance other than an expected reduction in overall performance. Relative ranks between subsystems were not possible since little is known concerning shiphandling performance with regard to subsystem characteristics.

One anticipated outcome was that the predictor steering display and other vector functions selectable on the situation PPI display would be helpful in training. Cooper and Bertsche (1979) found that

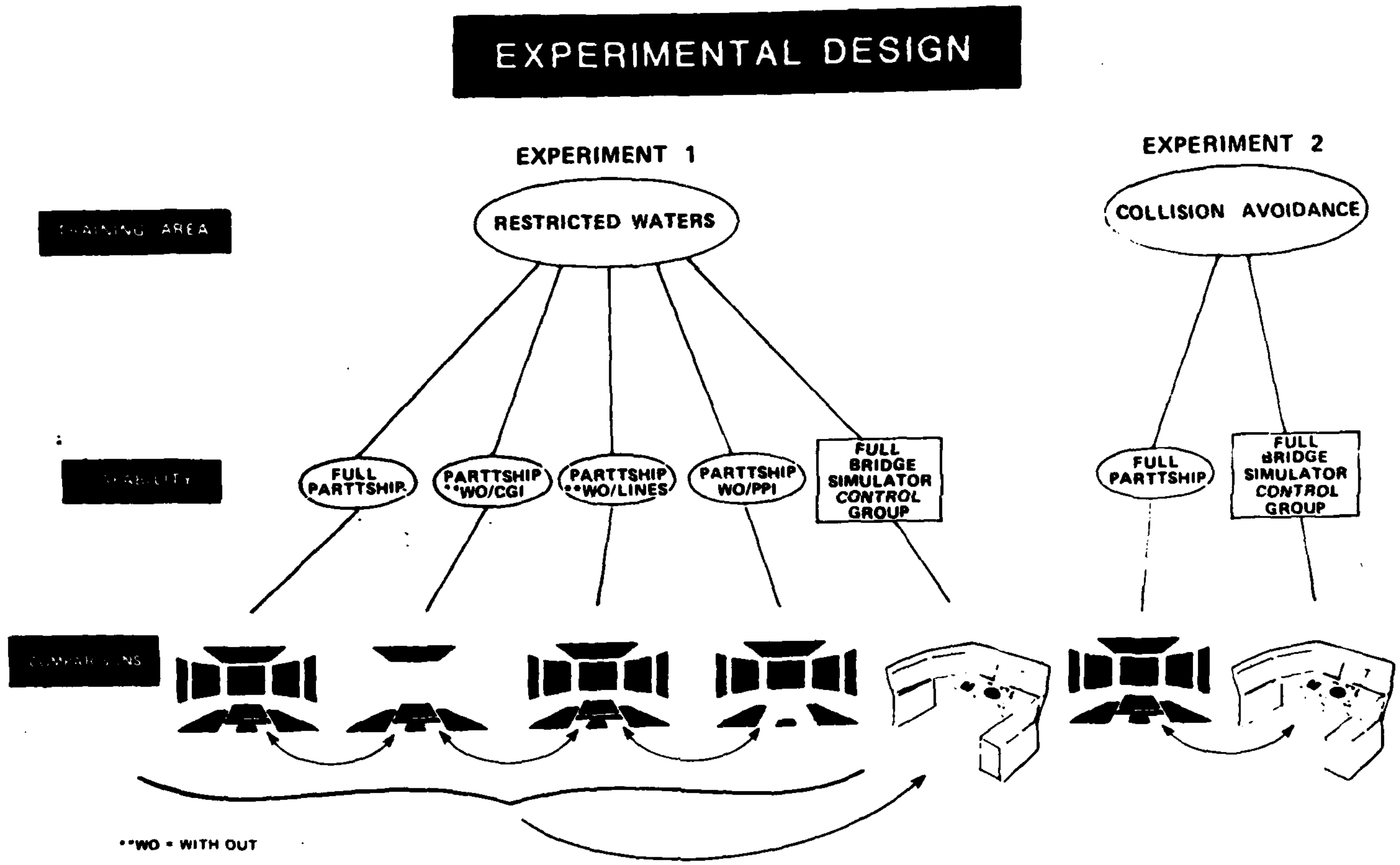

Figure 1-1. Experimental Design

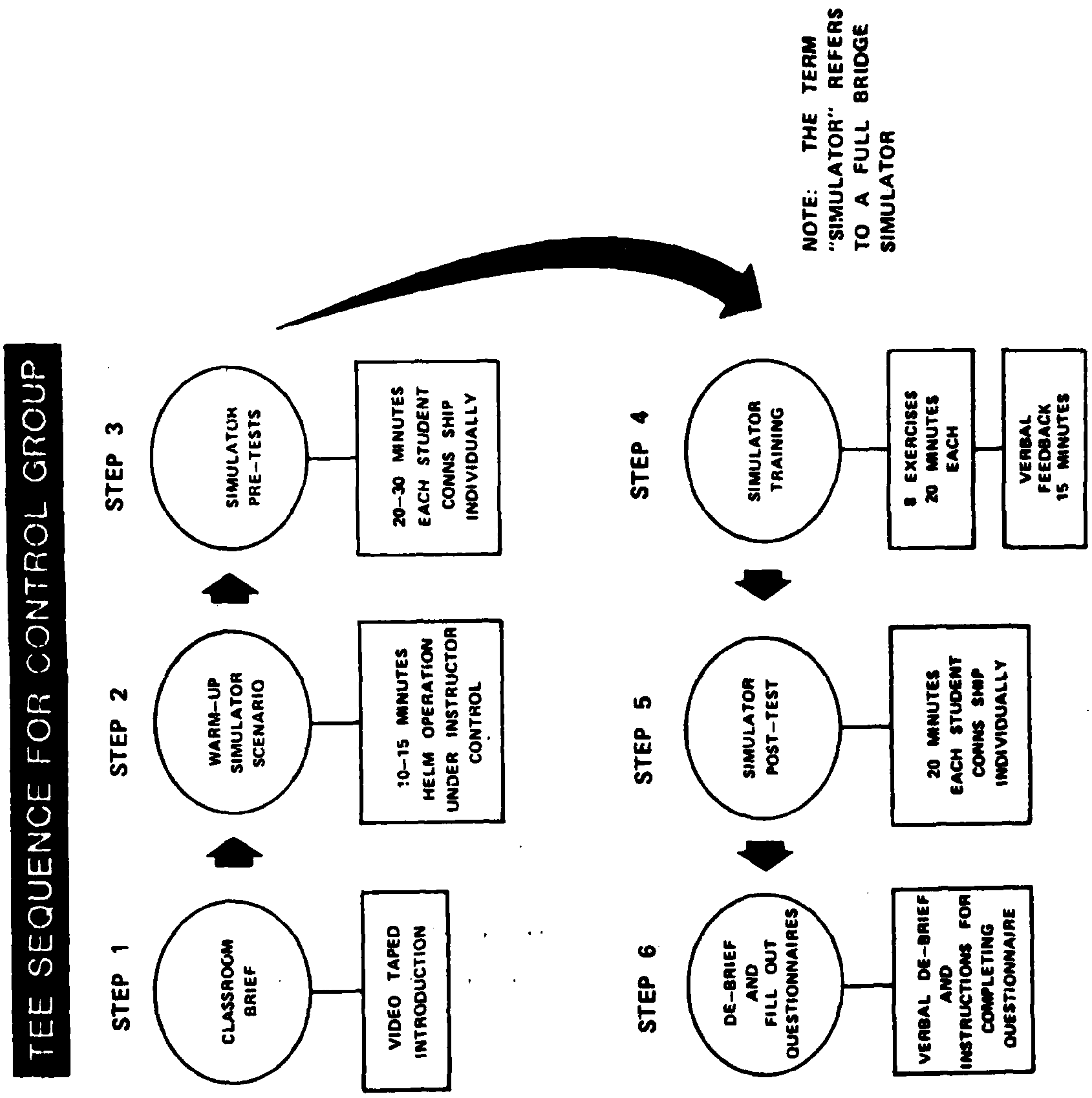

Figure 1-2. TEE Sequence for Control Group

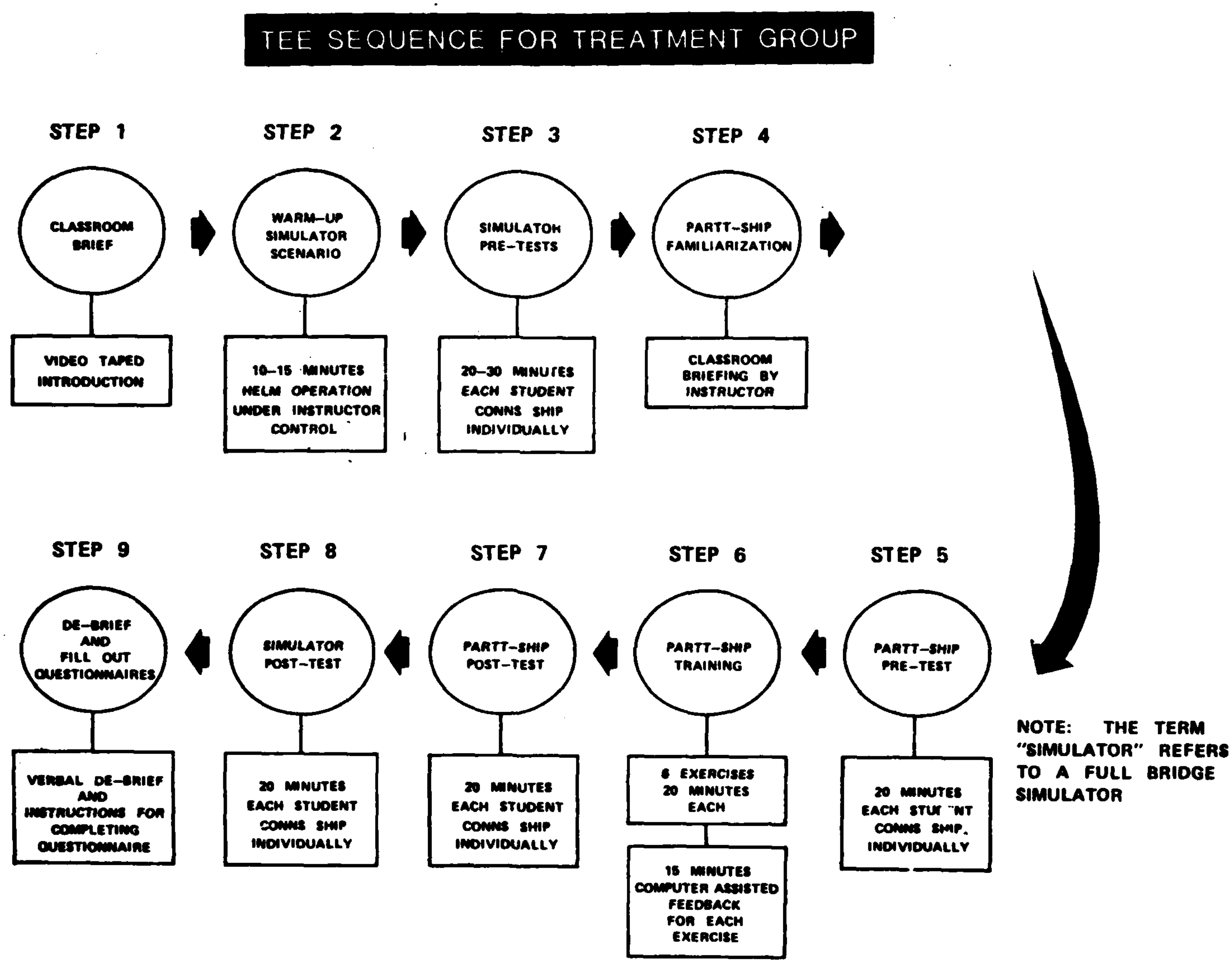

Figure 1-3. TEE Sequence for Treatment Groun

this display was not particularly useful as a shipboard operational display but was effective as a training aid. The subjects of that experiment were senior merchant mariners, however, so that predictions based on Cooper and Bertsche's findings about its effectiveness for junior naval officers, were made cautiously. In addition to population differences between Cooper et al and this study, were the differences in instructor use, training content, and training method.

Given that the training schedule for PARTT-SHIP experimental groups was rather ambitious (i.e., one familiarization exercise, four test exercises, and six training exercises), there was a question as to whether enough time was given to trainees so that they could become familiar with various training aids. In one day of training could trainees master use of ownship controls fast enough so that they could move on to special controls and displays? If a student was struggling with helm operation, PPI controls, communication devices, and at the same time trying to maintain plots and a mental image of the situation, would there be time to acquaint oneself with these useful but not so critical displays? To counter these possible problems with use of special displays several low stress, relatively easy, exercises were to be given first in practice to allow the student enough time between turns, contacts, etc., to become familiar with how to use these displays at appropriate times for specific kinds of information.

1.4.2 PARTT-SHIP vs. FULL BRIDGE COMPARSION. Several outcomes were possible concerning the relative training effectiveness of PARTT-SHIP compared to the full bridge simulator:

a. No difference between devices. This means either (1) that the PARTT-SHIP pre-prototype was as effective as the simulator for the limited amount of training completed during experimentation, (2) that the performance measures used were insensitive to real differences, or (3) that both devices were incapable of effecting behavior change. These last two alternatives were rejected as a result of conclusions from previous research (Hammell et al, 1981; Gynther et al, 1981). Alternatives 2 and 3 were rejected because performance measures used in both experiments were previously found to be sensitive to training differences (Gynther et al, 1981), and because the Computer Assisted Operations Research Facility (CAORF) at King's Point, N.Y. (similar to Ship Analytics full-bridge device but for detail of scene) has been shown to be effective, depending on what is trained and by whom (Hammell et al, 1981). Also, there is some CAORF data which substantiates simulator training as being effective.

b. Full-bridge Simulator more effective than PARTT-SHIP. This could certainly have been the outcome of both TEE experiments. Research has shown the large bridge simulator to be an effective training device in at least collision avoidance training (Gynther et al, 1981). The PARTT-SHIP device, however, is a pre-prototype about which nothing is known concerning its capabilities.

c. PARTT-SHIP more effective than simulator. This also was quite possible when considering the many training features that PARTT-SHIP was designed to accommodate. PARTT-SHIP has special PPI displays designed only for training purposes. Computer controlled tutorials were also available for refresher training of knowledge elements related to each scenario that was trained. A special question/cuing routine was designed to draw the attention of the trainee to important aspects of specific scenarios at appropriate times in each exercise. Except for situation PPI displays, none of these special features were tested individually.

1.5 PERFORMANCE MEASURES

At issue in these TEE experiments were the dependent variables chosen to reflect learning in one day of training. Although a great deal of data can be collected concerning movement of the ship, its position, communications, procedures, etc., performance measurement has often presented problems for simulation training research since a criterion measure of complex real-world performance is usually unavailable.

1.5.1 RESTRICTED WATERS MEASURES. For restricted waters scenarios, two dependent measures were chosen as primary: crosstrack distance (CRTD) and alongtrack distance (ALTD). Crosstrack distance measures the distance from where the ship is at any point in time compared to the intended track. In this case the intended track was the center of the channel. In fact, Navy ships usually lay out an intended track that is followed closely. Changes are made only to accommodate traffic or other environmental considerations.

Alongtrack distance is a measure of the distance traveled in a channel from the starting point to wherever the scenario ends. Total alongtrack distances averaged approximately 2 miles in each scenario shown in Appendix A. Since the goal of the conning officer is always to maneuver the ship from one point to another safely, ALTD is a logical index of performance. This is especially the case for these experiments because, in restricted waters exercises, any excursion from the channel that resulted in grounding, terminated the exercise. It is, therefore, not possible to make great errors in shiphandling safety and still proceed alongtrack.

1.5.2 COLLISION AVOIDANCE MEASURES. Collision avoidance scenarios presented a different context for performance measurement. Only one or two decisions decided the outcome of a scenario, while for restricted waters many small decisions added together as an average to indicate performance. Because commanding officers usually set strict limits on the projected distance allowable for their ship and a traffic vessel to pass, closest point of approach (CPA) was chosen as one performance measure.

Another measure for collision avoidance, that tends to vary directly with CPA in a given situation, is the range at which a maneuver is ordered. Early action is preferable in almost all rules of the road situations. This measure gauges the speed with which an officer makes his decision, right or wrong.

1.6 SUBJECTIVE TEE

As part of the TEE, a subjective evaluation was planned. This evaluation took the form of an opinion questionnaire concerning several categories of PARTT-SHIP design and function. The intention was to have each user rate the PARTT-SHIP pre-prototype based on their shiphandling experience. Both students participating in experiments and other Navy personnel taking part in pre-prototype demonstrations were asked to fill out the debriefing questionnaire.

Results of this subjective analysis were intended to identify deficiencies in design of the pre-prototype as derived from opinions of experts and students having trained on the PARTT-SHIP. Students, especially, would have first-hand experience in the capabilities of the pre-prototype for training.

Section 2

METHOD

2.1 DESIGN

The overall design for the two experiments conducted and the control and treatment groups are shown in Figure 1-1. The arrangement of TEE sequences for control and experimental groups are shown in Figures 1-2 and 1-3. Two experiments were conducted, one for restricted waters scenarios and another for collision avoidance.

2.1.1 COLLISION AVOIDANCE TEE. A before and after, pretest/posttest design was used to determine the effect of training. Pretests were administered to both control and experimental groups before training began to establish beginning skill level of students. Subsequent to completion of the training sequence, a posttest was administered. Stage of training (trained versus untrained) and type of training (simulator versus PARTT-SHIP) were two major independent variables representing a 2x2 design with one between groups factor (type of training) and one within groups factor (stage of training).

2.1.2 RESTRICTED WATERS TEE. Design of this TEE was identical to that for the collision avoidance area but for the addition of three other categories to the type of training factor. These other categories represented systematic reductions in the original complete PARTT-SHIP trainer configuration.

2.2 SUBJECTS

Subjects were 63 Surface Warfare Officer students from Surface Warfare Officer School (Basic), Newport, Rhode Island, who volunteered for participation in the experiment. Students came from classes of officers that had either graduated from the course and were awaiting orders, or were regularly attending classes and had completed at least the first third of the 17-week course. This ensured that students from any one of the several concurrent SWOS(B) classes had completed that portion of the course dealing with shiphandling theory. SWOS students had all been exposed to the classroom curriculum dealing with rules of the road, lights and shapes, and maneuvering board use. These skills were considered minimum prerequisite skills and knowledge that a student must possess. Additionally, a shiphandling theory screening test (Appendix B) was administered at SWOS(B) to guarantee a minimum level of knowledge considered necessary to benefit from the basic training capabilities of the device. Average rank was Ensign. The range of shiphandling experience was from students who had no experience to several students who were licensed as third mates, having graduated from the Federal Merchant Marine Academy. The average student had little on-board time and even less hands-on experience in shiphandling. Most students had made several

Yard-Patrol (YP) training runs on the patrol craft maintained by either the Surface Warfare Officer School Command or the U.S. Naval Academy. Naval Academy graduates had the most shiphandling experience as a group, since they had more access to sail training, YP runs, and had made summer cruises as part of their academy curriculum.

The Navy compensated students for their travel expenses to the training site in North Stonington, Connecticut, and for daily expenses such as meals. No other compensation was offered to subjects for their participation. The school command was asked to send homogeneous groups of three students each day, based on their entry source into the Navy, i.e., Naval Academy, Officer Candidate School (OCS), or Naval Reserve Officer Training Corps (NROTC). Since students were trained in groups of three, homogeneity of past experience within groups was controlled. This minimized pre-prototyping effects from experienced students that might mask the training effects on inexperienced students.

2.3 INSTRUCTOR

Throughout the test and training only one instructor was used. This minimized possible between group differences caused by different instructors. The instructor was a former qualified Surface Warfare Officer who was also a qualified Officer of the Deck underway on both a carrier and cruiser. He had also served on the staff of SWOS as an instructor in the Prospective Commanding Officer/Prospective Executive Officer course. He helped design the computer aided instructions program used on PARTT-SHIP, and designed all of the scenarios based on his own recent on-site survey of the Charleston, South Carolina, data base area. He came to the experiment well versed in use of the full bridge simulator used in this study. The feedback displays used were of the instructor's design based on existing and available computer generated imagery (CGI) formats. All interactions with the students were carried out by the instructor.

2.4 APPARATUS

Several pieces of special equipment were used to conduct experimental sessions. These devices were in addition to the PARTT-SHIP pre-prototype device itself which is described elsewhere.

a. PARTT-TASK Shiphandling Training Device Pre-Prototype. The pre-prototype (Figure 2-1) called PARTT-SHIP was used as a research tool to establish the degree of training effectiveness resulting from its current design. As a research tool, the PARTT-SHIP design is flexible and reconfiguration is possible to examine the unique contributions of its major subsystems to the total training effect. Each subsystem is explained in the following paragraphs.

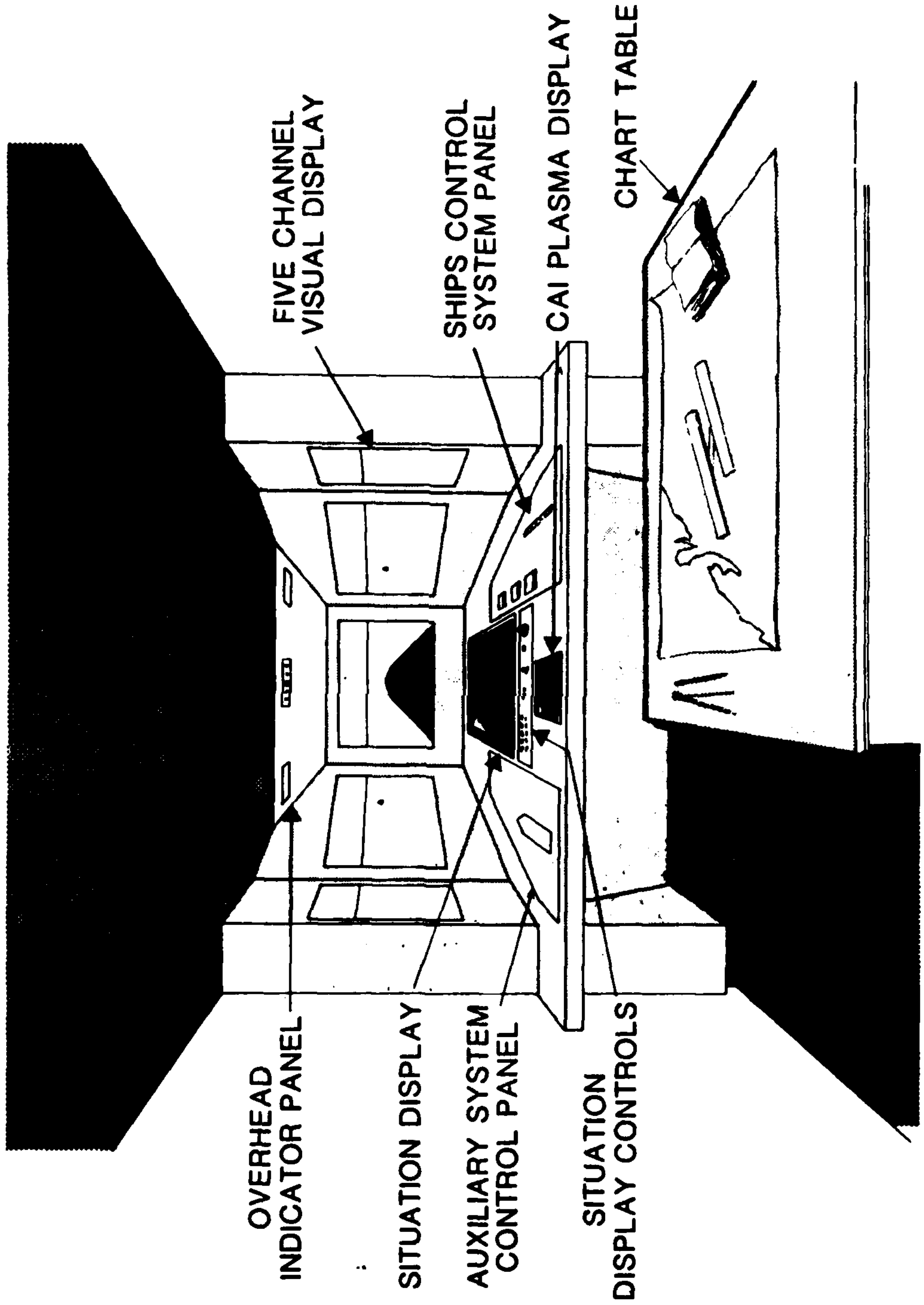

Figure 2-1. PARTT-SHIP Device

(1) Computer Generated Imagery (CGI). A computer generated imaging subsystem was provided that displays a 150-degree (75 degrees either side relative to ownship's forward longitudinal axis) horizontal field of view (Figure 2-2). The vertical field of view was 22.5 degrees, 5.6 degrees up and 16.9 degrees down). The scene was full color including ownship's bow and various day and nighttime images.

(2) Plan Position Indicator (PPI). A "birds eye" view CRT display of an exercise area was provided during exercises (Figure 2-3). Ownship was at the center of the screen. Land edges, piers, channel edge, etc., were shown in solid and dashed line format. The display was capable of supporting instruction in docking, anchoring, tug handling, and restricted waters navigation through a series of specialized display enhancements. A series of vector functions representing ownship's predicted, actual, and historic movements aided instruction in the concepts and principles of shiphandling.

(3) Computer Aided Instruction (CAI). Giving the student a means for individually operating the pre-prototype device allowed the instructor to focus on the quality of instruction and the needs of the student. Automation of this sequence reduced instructor burdens for mechanically controlling training. A dedicated CAI plasma display introduced the student to exercise objectives; gave tutorial by way of "help" functions prior to exercise run, scored performance and displayed feedback to the student. Subject areas were under the direction of the instructor and he controlled every portion of the training sequence.

Training scenarios were designed to simulate the real world demands of maneuvering a single propeller Navy combatant (FFG-7) in a channel, although any ship can be modeled. Variable wind and current effects were simulated in an ecologically valid manner to increase the difficulty of training scenarios according to the stage of training and skill level of a student. Wind and current variables were controlled by increasing their effect in standard increments for each trainee.

(4) PARTT-SHIP Functional Description. The PARTT-SHIP pre-prototype was enclosed in a training carrel with approximate dimensions of ten feet wide, six feet high, and six feet deep. It accommodated three students comfortably at the control panels. Students alternated as conning officer, auxiliary control panel operator, and helm operator. Auxiliary panel and helm operators were seated while the student acting as conning officer was free to move about the carrel. In addition to the trainer, the carrel contained a small chart table and a chart storage facility. Trainees not conning the ship operated the trainer under the direction of the student acting as conning officer. The instructor manually controlled a fixed sequence of assigned instructional steps. Exercises were selected by the instructor but each simulator exercise scenario was initialized automatically. The trainee could

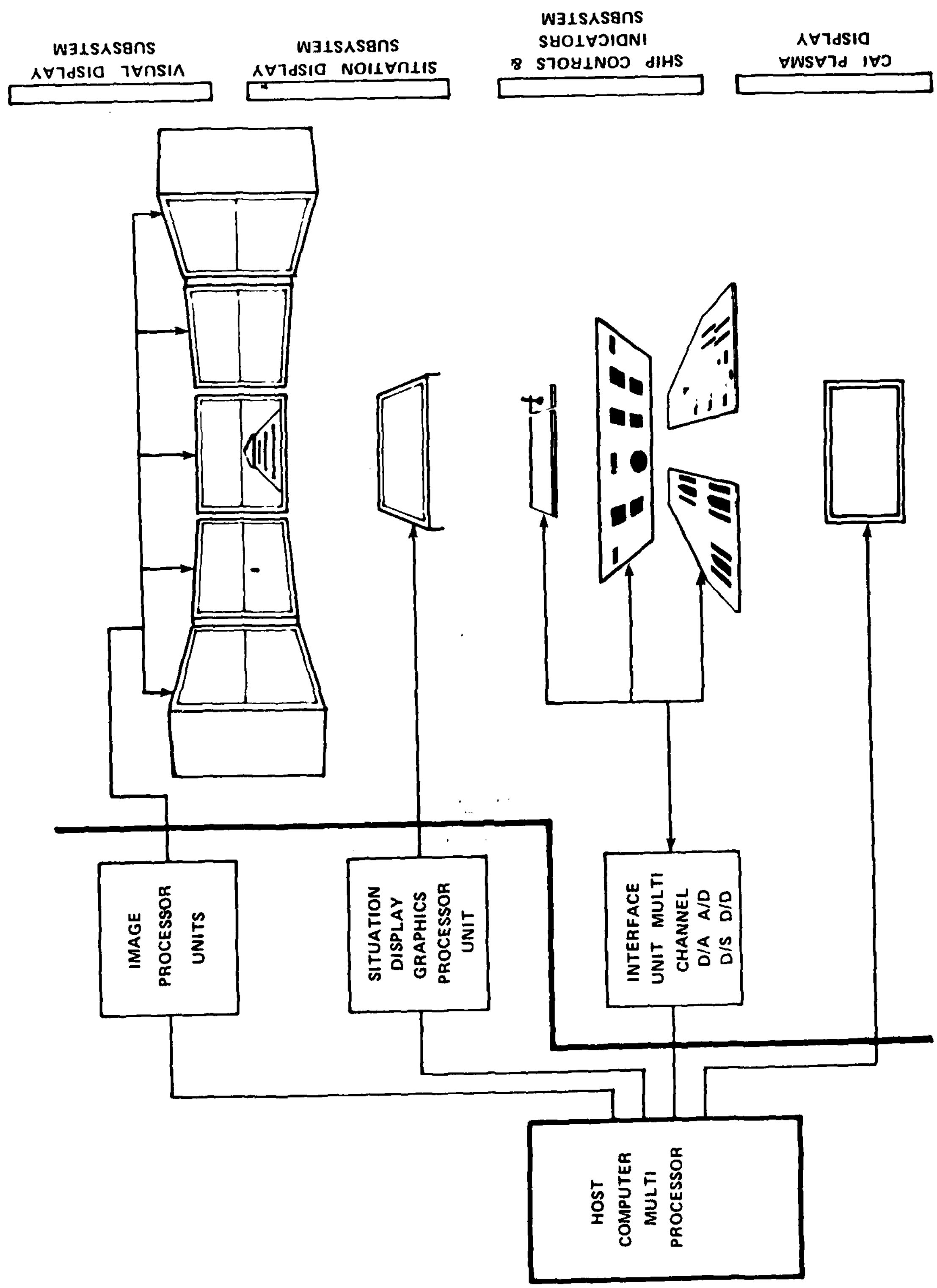

Figure 2-2. PARTT-SHIP Subsystems

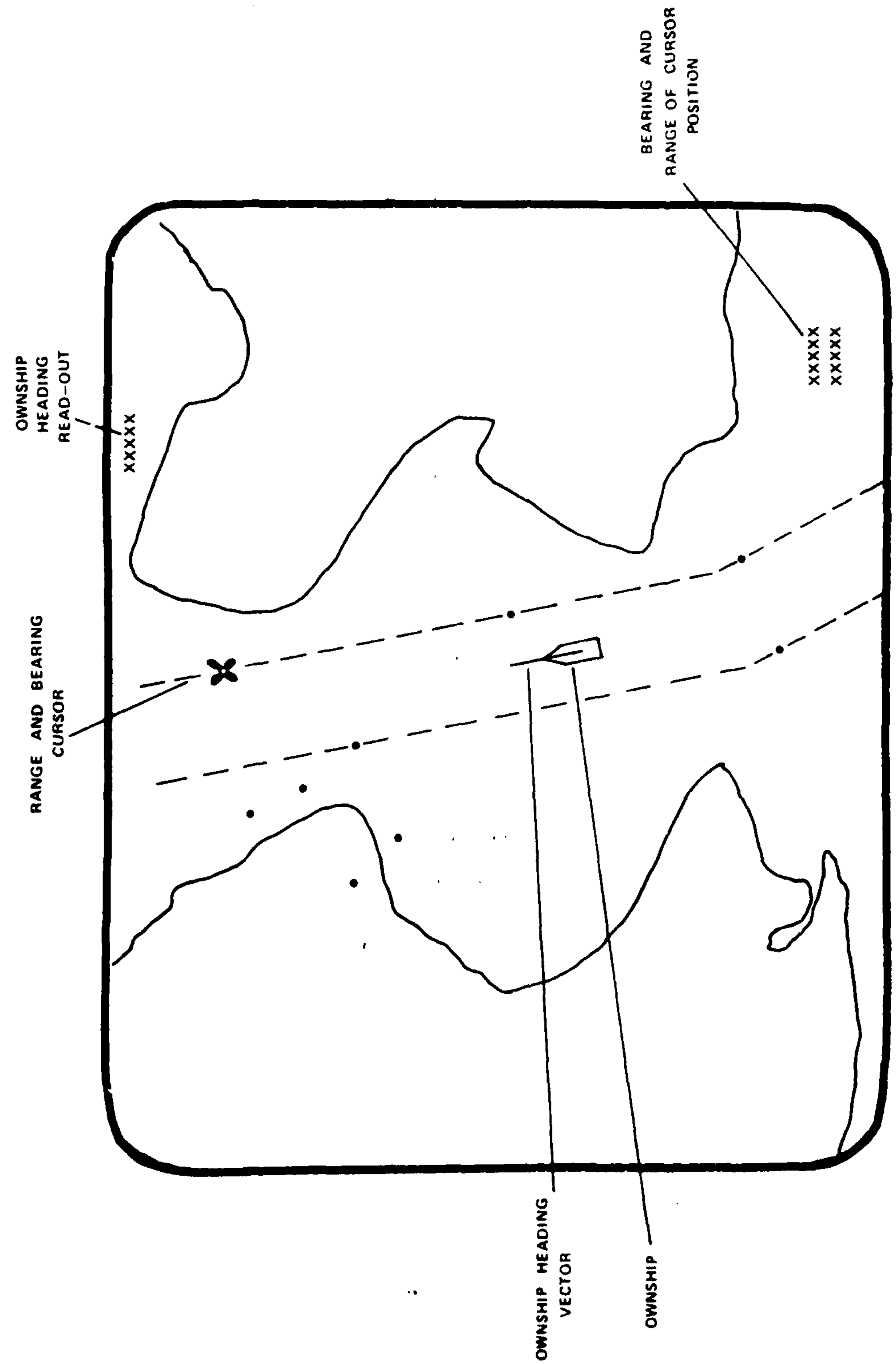

Figure 2-3. Typical Plan Position Indicator Display

run, freeze, or terminate the exercise scenario. Performance measures were automatically recorded by the PARTT-SHIP device and were displayed as instructional feedback following exercise scenarios. In a production mode, it is anticipated that many of the functions currently performed by the instructor could be automated.

The device provided a real time, dynamic simulation of a selected ownship (FFG-7 for this TEE) and exercise area (Charleston, South Carolina). Generic stylized ship controls were provided which allowed the trainee to control the ship's rudder, engine, propeller pitch, auxiliary propulsion units, anchors, and servicing tugboats. The status of these controls and ship performance parameters were displayed on generic indicators. The principal display for the trainee was CGI in a five-Cathode Ray Tube (CRT) configuration that comprised a 150-degree horizontal field of view. This was coordinated with an enhanced plan position indicator (PPI) representation of the geographic area that provided a "birds-eye" view of the exercise and ownship's position. The situation display also presented the future course of the ship based on external sources acting on the ownship and an estimated prediction of the ship maneuvering response to various trial rudder and engine commands. The visual system used CGI technology that generated images of simple aids to navigation, docking structures, and ownship's bow for day conditions. Night conditions consisted of lights on traffic ships, and cultural objects/land for night conditions. The training device could be operated with either or both the situation display and visual display systems.

The FFG-7 pre-prototype included auxiliary propulsion unit characteristics, autopilot, passing ship interactions, anchor effects, tug effects, wind, and current effects. Figure 2-2 is a simplified system diagram of the PARTT-SHIP hardware configuration that was developed for the demonstration pre-prototype. Major subsystems were:

- CAI controls and display systems
- Ship control and indicator subsystem
- Situation display subsystem
- Visual display subsystem

The pre-prototype was driven by a host computer multiprocessor that controlled the functions of image processing units, radar graphics processors, and a multichannel interface unit.

(5) Situation Display. The situation display was provided to allow the student an enhanced navigation and maneuvering display in place of a traditional radar. The PARTT-SHIP pre-prototype was not a radar trainer. The PPI display was a situation presentation format that was chosen over a traditional radar display because of its increased training capability through special instructional features.

The display included distinct symbols for anchors, tugboats, piers, and other navigational aids. Channel boundaries showed areas and motion vectors that were displayed on the PPI to aid the student in negotiating various restricted waters situations. A special set of vector functions were included as part of the PPI capability that displayed past ownship track information, a predictor steering feature, and a scenario freeze capability. The trainee could choose to examine his historical performance or up to 3 minutes of the ships predicted future course. These functions were carried in fast time while the scenario was run or was frozen. Traditional radar features (i.e., range and bearing) were also displayed. Using a PPI representation, the student was less apt to attempt mastery of radar operations since operation of the PPI situation was simplistic. Operating device controls demanded little attention from the trainees to increase the probability that the student attended to the principles and concepts of shiphandling rather than the mechanical operation of the trainer.

(6) Bridge Controls. The generic bridge design included a number of stylized controls and indicators that were included to reduce the amount of familiarization time necessary within the trainer before training could begin (Figure 2-4). The controls were simple pushbuttons which simulated the function of real world bridge equipment. The stylized generic nature of the controls and indicators made the training device applicable across a wide variety of ship classes and ship types without sacrificing face validity. The goal of the design was to make the operation of the trainer straightforward and simplistic. This minimized the necessary task demands for operating the device so that students could pay attention to the important information being displayed in the visual scene, situation display, and computer aided instructional display.

(7) Gaming Area. The nature of CGI systems is such that reprogramming of new gaming areas or switching from one gaming area to another can be done rapidly and inexpensively. Any number of major U.S. Navy ports or other ports of interest may be called upon for instructional purposes limited only by computer storage capacity and data base availability. Special features of each gaming area are accurately programmable since the environmental equations that pre-prototype each data base are sophisticated. The effects of bank, cushion, shallow water, passing ship, current, wind, bottom composition, and a number of other environmental parameters were designed into the hydrodynamic equations that control the portrayed motion of ownship through the gaming area. Charleston, South Carolina (Cooper River) was the selected gaming area for all TEE exercises.

(8) CAI Functions. A computer aided instructional capability was designed for use before, during, and after exercise run. No shiphandling trainer presently uses a CAI feature. These functions were used to explain the exercise objectives and performance feedback information to the student. Additionally, CAI

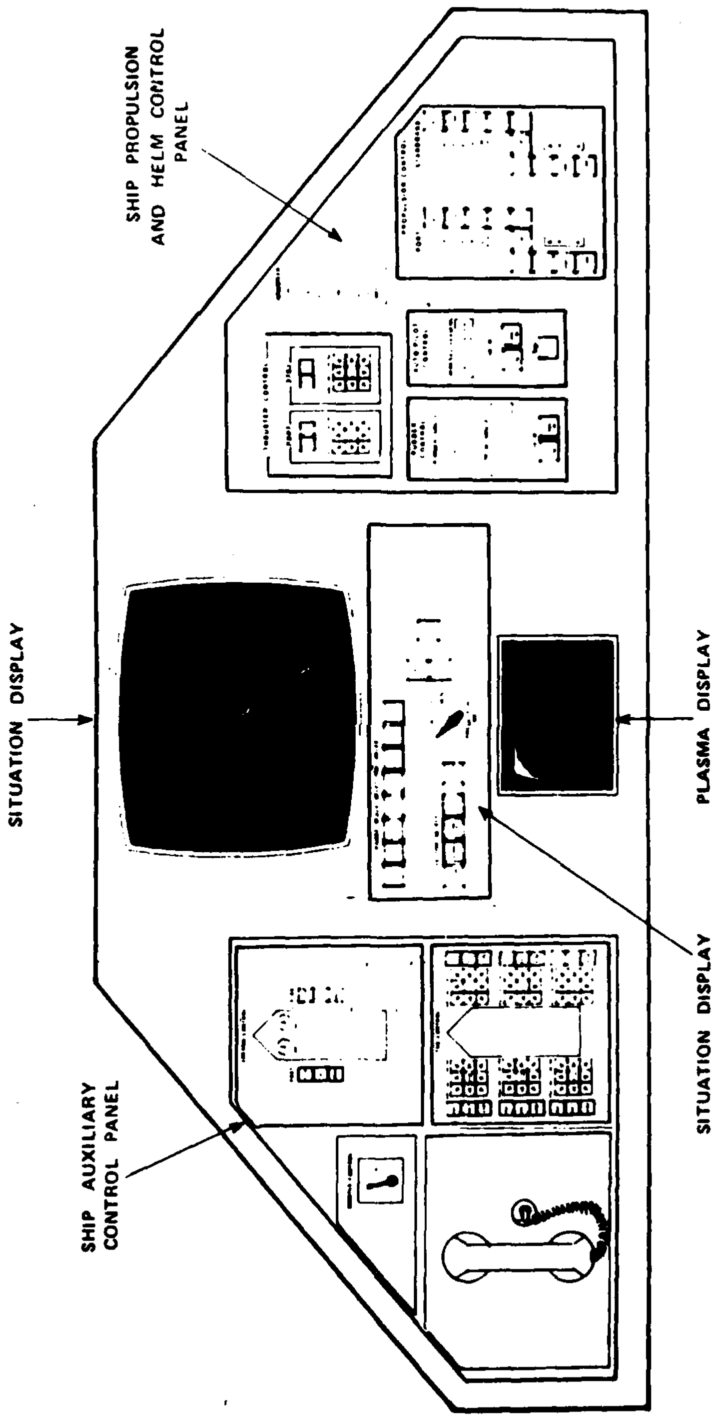

Figure 2-4. PARTT-SHIP Bridge Control Panel

functions interrupted training scenarios to question the trainee concerning various exercise scenario features with which the student should have been familiar or should have anticipated during the exercise run. Those features cued the trainee to direct attention to important features within the exercise. It was also a means by which the instructor could judge how well the trainee was absorbing the instructional materials.

Before exercise run, a PARTT-SHIP "help" feature could have been called upon for a brief tutorial of principles and concepts related to the scenario. The trainee needed only to touch the appropriate area on the plasma "help" display for a number of various menus to appear within which the student could select (Figure 2-5). Several levels of branching were designed so that the student could access the level of instruction required for his particular entry level skills and knowledge.

b. Large Screen Display. As part of the classroom facility a large screen (48 inches high by 60 inches wide) Advent front projection system was used for presenting video taped exercise prebriefings as well as a familiarization video tape. The video taped displays were driven by an Hitachi video tape recorder pre-prototype VT-9700A.

c. Lighted Clipboard. Each student and the instructor serving as conning officer was given a lighted clipboard consisting of a storage section, a writing surface, and a flexible red bulb penlight flashlight. The lighted clipboards were used to store current chartlets, and to serve as a writing surface for note taking during night exercises.

2.5 PROCEDURE

2.5.1 FAMILIARIZATION. Upon arriving at the training facility, students were given a video taped familiarization briefing. Video taped briefings were chosen to standardize the information given to each group of three students. Each briefing was identical for topics covering: purpose of training, daily schedule, and facility layout.

Those subjects serving as members of the treatment group (i.e., all PARTT-SHIP training groups) were given an additional video briefing covering the controls and displays of the pre-prototype.

Subjects were introduced to the full bridge simulator before a familiarization exercise. All controls on each piece of bridge equipment were explained by the instructor before the familiarization exercise commenced. Hands-on experience with various bridge equipment was given to each student in the form of 10 to 15 minutes at each bridge team position during a 30 to 45 minute familiarization exercise. This exercise consisted of a daytime channel marked with buoys and ranges. The purpose was to introduce

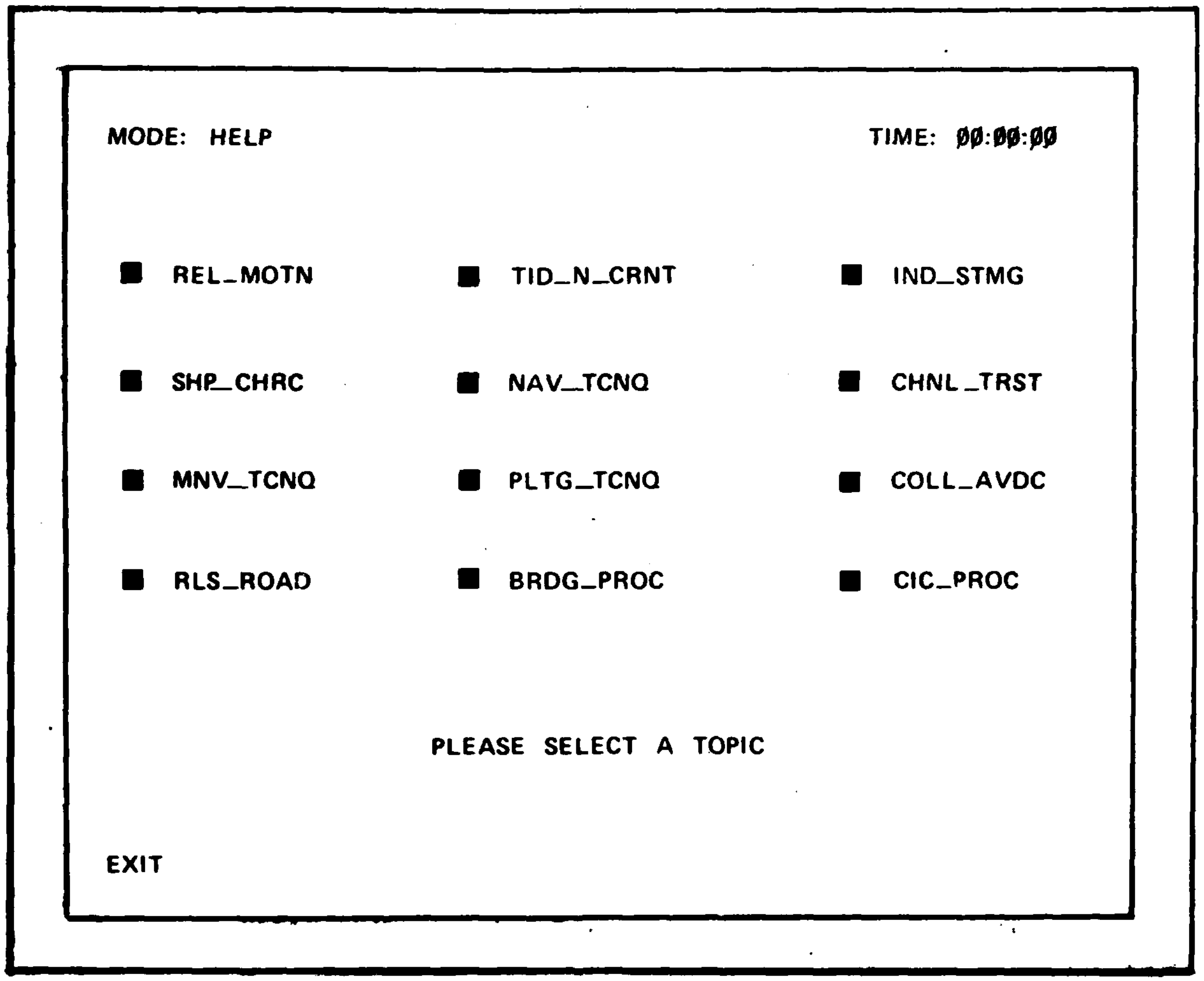

Figure 2-5. Plasma Console Showing an Example of a Tutorial "Help" Menu

the student to CGI, PPI displays, and the bridge team organization within which he or she would train. Serving as helmsman, Quarter Master/Navigator and Conning Officer during familiarization allowed each student time to understand the responsibilities of that position, and to briefly refresh and practice previously learned bridge team procedures. Additionally, it was expected that each student would acquire a feel for the handling characteristics of the FFG-7 class ship modeled in computer software. This was the only ship pre-prototype used in test and training exercises. Each student made turn maneuvers during familiarization as a means of coordinating the visual and radar display information with relative motion of buoys and range markers. Throughout familiarization, the instructor gave guidance and answered questions concerning operation of the simulated ship.

2.5.2 PRETESTS

2.5.2.1 Restricted Waters Pretest. After familiarization each student was given a set of charts that described various portions of the port of Charleston, South Carolina. Each chart corresponded to an exercise for either test or training. A video taped introduction to the pretest exercise was given to each group of three students. Restricted waters pretests on the simulator were a nighttime scenario. Tapes contained descriptions of the exercise area including navigational aids, wind, current, names of reaches, initial speed, course, and duration of exercise. Students were given charts that described the wind and current modeled in each exercise (Appendix A).

a. Training and Test Sequence. Following pretest exercise prebriefing, one student was selected to be tested first while the others were asked to be seated in an area separate from the classroom and simulation. This was done to minimize the possibility of indirect experience gained through watching the student being tested. Waiting students sat in a nearby conference room isolated from the classroom and test activities. Shiphandling materials, not related to scenarios, were given to waiting students which they could read at their option. The sequence for individual pretests was followed again on posttests and during training scenarios for rotation of the three bridge positions. The first student to be pretested, therefore, was the first to serve as Conning Officer during training and then first again to be posttested.

b. Helm Operation. To minimize error from variance in helm control, a member of the training staff served as helmsman for all testing sessions. The helmsman followed orders as given with no correction for improper course, engine, and helm commands. During pretesting and posttesting, Conning Officers were not allowed to order the helmsman to steer a course. Instead, students were told to give direction and magnitude of rudder desired to attain the intended course. In this way, the Conning Officer would have to

command direction of rudder use, magnitude of rudder, shifting rudder, etc.; so that the instructor could better evaluate the student's maneuvering skill and knowledge of his ship and the environment.

All pretests and posttests in restricted waters were given with the student's understanding that the special sea and anchor detail had been set. Communications with the Captain were accomplished with a pushbutton telephone as were any other intership and intraship communications.

c. Instructions. Exercises were designed to last approximately 20 minutes. Students were begun at a point in the channel 100 feet to the right of centerline. Instructions to the students were that they should, at all times, attempt to stay in the center of the channel and that they would be evaluated on how well they accomplished this goal. Additionally, students were told that there would be no traffic in the channel. Before the beginning of the pretest, each student was allowed approximately 5 minutes of time to become familiar with the chart, the radar display, the visual scene, and was told the initial conditions of ownship and environmental forces. No questions about any of the displays or the chart were answered before or during exercise run.

During pretest there were only three people on the bridge: the instructor, the helmsman, and the student serving as Conning Officer. The instructor recorded data on an observer data collection form contained in Appendix C. No questions were asked of the student during pretest nor were any answered that pertained to exercise information, e.g., the identity of a buoy, characteristics of a range, etc. When questions of that nature were asked, the instructor told the student to answer the question by using available resources, such as the current charts, large charts and the existing visual and/or PPI scenes, and the student's own judgment.

d. Pretest Termination. Pretest continued until the student either finished the transit or made an excursion from the channel. Excursions were defined by the center of gravity of ownship crossing the channel boundary for which, in the instructor's opinion, no chance of recovery from grounding was possible. No individual performance feedback was given on pretest performances, but a group debriefing was given after the last student in the group had completed the test. Not finishing the pretest penalized the student in terms of percent along track distance completed. Also, for cross track distance, an excursion usually contributed large values to average cross track distance, thereby lowering his performance score.

e. Remote Monitoring. Training and testing on the simulator were monitored in the classroom through a low light video camera, a radar repeater, and audio. These were not available for the

PARTT-SHIP. An audio monitoring device was used in place of the video camera for all PARTT-SHIP exercises. In addition to these remote monitoring capabilities, a VT-100 terminal was available that displayed all ownship's propulsion and steering parameters including crosstrack distance in the channel (CRTD), alongtrack distance (ALTD), wind, current, heading, course, speed over the ground, engine rpm, propeller pitch, trainer mode, and exercise time. These monitoring capabilities allowed the instructor to closely monitor the position and movement of the ship at any point in time, and the activities of the bridge team.

2.5.2.2 Collision Avoidance Pretest. Procedures for these pretests were similar to restricted waters pretests. Since one of the training objectives of collision avoidance was to collect available information concerning contact speed, course, aspect, etc.; prebriefings were unnecessary. Prebriefings were not necessary for collision avoidance exercises because all the information the student needed was available on the control settings on the bridge. Additionally, wind, current, etc., were of no consequence in these open ocean scenarios, since there was none programmed into the exercise. As part of problem solving and decision-making, it was up to the students to collect contact/target information and develop the geometry on their own. Giving them the contact bearings, courses, speeds, etc., would have solved much of the collision avoidance problem for them. Charted information was also purposefully omitted since all collision avoidance training and test scenarios were conducted in open ocean areas. Students were instructed to use both traffic vessel running light information in the visual scene and radar information to establish the situation. Students were given the materials necessary for making rapid scope head radar plots in addition to maneuvering board materials. Again, during pretest no questions were answered when asked unless there was some confusion over equipment operation. Students were required to conn the ship and maintain whatever plots they required. All collision avoidance exercises were night scenes.

a. Instructions. Each student was given a set of commanding officer night orders and standing orders to adhere to as closely as possible. Copies of these documents are contained in Appendix D.

b. Communications. Communications with the commanding officer and traffic vessels were made by use of a pushbutton telephone. During the pretests and posttests, the instructional console operator in the classroom operated the phones. This operator was directed to not give any information or advice to the student. Operators were trained in Navy standard communication procedures and terminology. In all cases, when calls were made to any station or vessel, answers were made by the instructional console operator. In all pre- and posttests, none of the calls to traffic vessels were answered. Traffic vessel movements were all preprogrammed.

Although this is not satisfactory for all training purposes, it was a necessary constraint on test scenarios. This assured that all students had the same information upon which to base their decisions.

When calls were made to the Captain concerning intended actions to avoid collision, the response to the student was to carry out whatever the student thought best. In this way, no guidance was available to the students concerning the correctness of their decisions.

Most pretest scenarios required one maneuver of a reasonable magnitude in the correct direction to avoid a collision and to maintain the Captain's ordered minimum CPA. Once the student gave his initial course change commands and steadied up, the instructor would ask the student if this was the final solution to the problem. If the student answered affirmatively, the scenario was ended and the final CPA recorded. If not the scenario would continue until the student mentioned that the final solution was attained or until CPA was achieved to the contact of interest.

2.5.2.3 PARTT-SHIP Pretests. Before training commenced on the PARTT-SHIP device, a pretest was given to all trainees who would train on the pre-prototype device (Figure 1-3, Step 5). This was done for all PARTT-SHIP groups regardless of the trainer configuration used.

All pretests were identical regardless of the PARTT-SHIP configuration assigned to each treatment group. Pretest scenarios did not include channel outlines (WOL) that were displayed during most training exercises. Although vector displays were available on the PARTT-SHIP PPI display, students were limited to a heading vector displayed for all pretests. This vector function could not be turned off by the trainee. Like all simulator pretests, the student had full control of ownship's helm and engines after scenario initialization. In all other respects, pretests on the PARTT-SHIP pre-prototype were procedurally identical to simulator pretests.

2.5.3 TRAINING. Major differences between control and experimental (PARTT-SHIP) groups consisted of special PARTT-SHIP displays available during training and the physical size of the trainer. Specific differences between groups were that experimental PARTT-SHIP groups had:

a. Tutorial displays available for up to 5 minutes before training exercises

b. Special vector functions available on PPI situation display*

c. Training exercise questions and prompts occurring during exercise run

d. Computer generated feedback displays given on the PARTT-SHIP center screen

e. A PARTT-SHIP device, smaller in physical size and operated by stylized controls

f. Six training exercises (two less training exercises than simulator control groups) were given to PARTT-SHIP groups. This afforded equal training opportunities to both experimental and control groups. Note that the experimental group had two pretests and two posttests (two on PARTT-SHIP and two on the simulator). The control group had a total of two tests. Figures 1-2 and 1-3 illustrate this point.

Any and all questions were answered during training exercises. Feedback was given to the student during and after the training scenario. PARTT-SHIP generated questions only while in the RUN mode. The timing of questions was tied with various scenario events so that (after the first question) a new question appeared every 2 minutes that was appropriate for that time in the scenario. During a run, immediate feedback was given concerning answers to five preprogrammed questions occurring at 1 minute into the scenario, and then every 2 minutes afterwards.

SAMPLE

At what point in transit should the special sea and anchor detail be set?

A. By order of commanding officer
B. By standing orders
C. Use OOD's discretion
*D. Both A and B are correct

Additionally, immediately after training, a series of tabular, geoplot, and X-Y coordinate plots were used as delayed feedback. During feedback, given in exercise postbriefs, the instructor annotated displays pointing out salient aspects.

Students shifted bridge positions in a fixed sequence for every succeeding training exercise. (That is, the student acting as Conning Officer would take the helmsman position, the student acting as helmsman would take the Quarter Master/Navigator position and the student acting as Quarter Master/Navigator would take the Conning Officer position.)

*One of the four experimental groups did not use a PPI display at all. See Figure 1-1.

2.5.3.1 Training Exercises Restricted Waters.

a. Control Group. Three groups of three students (n=9) served in a simulator control condition. These students were trained in a traditional manner consistent with many existing simulators. The traditional methods used consisted of practice exercises that were identical in all respects to training exercises for the treatment groups. Exercises averaged 20 minutes in length unless the team made an excursion from the channel. Given an excursion, the exercise was stopped by the instructor at a remote monitoring station in the classroom. Students served as Conning Officer, helmsman, or QM/Navigator. The roles of these bridge positions were essentially the same as those found on Navy ships except that typical Navy bridge shiphandling team organization includes many more members. Control groups trained only on the full bridge device.

Trainees were told that they should utilize a standard Navy bridge organization and maintain good communications and bridge procedures in accordance with the Commanding Officer's standing orders.

A total of eight training exercises were run for the control group. These exercises included the standard prebrief given previous to the commencement of exercise run. Any questions concerning any aspect of training exercises were answered before, during, or after exercise run. Students were not prohibited from consulting with one another, but Conning Officers were informed of their accountability as Conning Officer/Officer of the Deck and told that the performance data collected would be recorded in their name and would be attributed to their performance during the training day. This was done to motivate individuals and ensure that their performance was at its best.

As with pretest and posttest exercises, an excursion from the channel ended the scenario, but near excursions and minor excursions from the channel boundaries were tolerated as long as the ship would not have gone aground in a real world channel. At the end of each exercise students were brought back to the classroom and were seated during the instructor postbrief. These groups correspond to those capabilities shown in the bottom of Figure 1-1 and in Tables 2-1 and 2-2. These postbriefs were approximately 5 to 10 minutes long depending on the scenario, and consisted of verbal feedback in addition to instructor diagrams drawn on a chalkboard. Students were allowed to take notes and ask questions during these postbriefing sessions. No computer generated feedback displays or hardcopy displays of the geoplot or other types of feedback displays were given to the trainees in the control group.

The design concept of various types of feedback, e.g., delayed and immediate in the several different forms of geographic, tabular and X-Y plots was contained in the PARTT-SHIP functional

TABLE 2-1. RESTRICTED WATERS TEE DESIGN

PARTT-SHIP Experimental Treatment Groups																Control Group	
Full Device Training				PARTT-SHIP Training Without CGI				PARTT-SHIP Training Without Channel Outlines				PARTT-SHIP Training Without PPI				Simulator Training	
Simulator		PARTT-SHIP		Simulator		PARTT-SHIP		Simulator		PARTT-SHIP		Simulator		PARTT-SHIP		Simulator	
Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
S1	S1	S1	S1	S10	S10	S10	S10	S19	S19	S19	S19	S28	S28	S28	S28	S37	S37
S2	S2	S2	S2	S11	S11	S11	S11	S20	S20	S20	S20	S29	S29	S29	S29	S38	S38
S3	S3	S3	S3	S12	S12	S12	S12	S21	S21	S21	S21	S30	S30	S30	S30	S39	S39
S4	S4	S4	S4	S13	S13	S13	S13	S22	S22	S22	S22	S31	S31	S31	S31	S40	S40
S5	S5	S5	S5	S14	S14	S14	S14	S23	S23	S23	S23	S32	S32	S32	S32	S41	S41
S6	S6	S6	S6	S15	S15	S15	S15	S24	S24	S24	S24	S33	S33	S33	S33	S42	S42
S7	S7	S7	S7	S16	S16	S16	S16	S25	S25	S25	S25	S34	S34	S34	S34	S43	S43
S8	S8	S8	S8	S17	S17	S17	S17	S26	S26	S26	S26	S35	S35	S35	S35	S44	S44
S9	S9	S9	S9	S18	S18	S18	S18	S27	S27	S27	S27	S36	S36	S36	S36	S45	S45

Pre = Pretest
Post = Posttest

TABLE 2-2. COLLISION AVOIDANCE TEE DESIGN

PARTT-SHIP Experimental Treatment Group		Control Group	
PARTT-SHIP Training		Simulator Training	
Pretest	Posttest	Pretest	Posttest
S46	S46	S55	S55
S47	S47	S56	S56
S48	S48	S57	S57
S49	S49	S58	S58
S50	S50	S59	S59
S51	S51	S60	S60
S52	S52	S61	S61
S53	S53	S62	S62
S54	S54	S63	S63

specification (Hanley et al, 1981). These training considerations have not normally been a design feature of simulators. Some support for their effectiveness was found by Gynther, Hammell and Grasso (1981) when evaluating several levels of training performance feedback within a rules of the road training program. Although not called out as a separate variable, it was assumed that training assistance technology (TAT) would have a similar positive effect on training outcomes for PARTT-SHIP groups. These features were not contained in the full bridge training although they could have been easily added. The rationale was that most full bridge simulators in the world today do not have these features. To compare PARTT-SHIP to a non-normal or average bridge simulator would have constrained the generality of findings. Therefore, the groups trained on the full bridge were given aural feedback along with chalkboard diagrams of the training performance, as debriefing.

A sequence was established during pretest for the order in which students would assume the conn. During each successive exercise the bridge team changed positions so that each team member got approximately the same amount of exposure to each of the three bridge team positions. This sequence was arbitrarily determined and was not based on any screening material or background data gathered before the training session began. Track charts, current charts, and other handout materials were the same for every group trained in the restricted waters experiment. The difference between control groups and the treatment groups were primarily in the types of feedback given to the trainee during and after exercise run and, of course, the devices used for training. One set of identical scenarios was used for experimental and control groups.

No attempt was made to equalize or balance groups in the treatment or control conditions based on screening or other background data. An experimental sequence for the seven types of groups to be run was determined previous to the beginning of the experiment. These groups correspond to the various trainer capabilities shown at the bottom of Figure 1-1 and in Tables 2-1 and 2-2. This sequence was not changed throughout the conduct of the experiment. A total of three restricted waters control groups were run within the restricted waters experiment.

b. Restricted Waters Experimental Groups. Twelve of the restricted waters groups were given training on various versions of the PARTT-SHIP device. Figure 1-1 shows the various configurations of the trainer for the respective treatment groups.

1. Full. The first of these groups was called PARTT-SHIP full, denoting complete pre-prototype capabilities. For comparison purposes, this group trained with the pre-prototype that had full CGI, PPI, and channel outlines on the PPI situation display. Other groups were trained without one of these capabilities within the trainer.

2. Without CGI (WOCGI). The group trained WOCGI capability were shown a bow image only. No other visual information was available. This group relied almost totally on the situation display that contained radar-like information and various training displays.

3. Without PPI (WOPPI). A third group was trained without the situation display (WOPPI) but had a full computer generated imagery visual scene. For the without PPI group, the situation display was turned off so that no plan position information was available. All range and bearing information had to be collected from the CGI visual scene.

4. Without Channel Outlines (WOL). A fourth group was trained with all the PARTT-SHIP capabilities except channel outlines that normally accompanied the radar like situation display. Early work with PARTT-SHIP revealed that novice students appeared to be drawing their maneuvering cues almost exclusively from the PPI display. Further examination showed that the students were attempting to keep the PPI outline of their ships in the middle of the dotted lines representing the channel outline. The students seemed to be using these lines as if they were playing a video game. ("As long as my ship outline is between the dotted lines I'll be O.K."). The decision was made to examine the use of these lines more closely to determine their effectiveness as training tools.

This group of students was originally intended to be trained without access to the computer tutorials. However, this procedure was modified when it was discovered that the computer controlled tutorial displays were not being used by the trainees. Lack of use was attributed to the content of the tutorials, the relatively advanced level of the students, and lack of time. Tutorial displays contained shiphandling concepts, rules and principles. All displays were provided as text and therefore were rather limited in conveying dynamic concepts. This capability was not fully developed because of the limited resources available. As text only, these displays were difficult to read and understand when representing spatial or dynamic concepts/principles. This may have accounted for lack of use. Also, the lack of familiarity with these displays and their use in the limited training time available may not have been sufficient to make their value apparent to the student. A WOL group was, therefore, substituted.

2.5.3.2 Collision Avoidance Training Exercises.

a. Control Groups. These groups (n=9) followed the same sequence as the control group for restricted waters. Except for the content of exercise scenarios, prebriefings and feedback, all training procedures were identical to restricted waters scenarios. Collision avoidance training groups were given oral instructor briefs before each exercise that contained only ownship information such as course, speed, and heading.

b. Experimental Groups. The only differences between control group training and PARTT-SHIP groups were the displays used as PARTT-SHIP feedback and the features of the PARTT-SHIP device (e.g., training displays on the PPI console).

2.5.4 POSTTESTS

2.5.4.1 PARTT-SHIP. Following the last training exercise, a posttest was given to each student on the full bridge device. Procedures were identical to pretests of restricted waters and collision avoidance training groups.

2.5.4.2 Simulator. All 63 subjects were given a simulator posttest. Scenarios were identical on posttest to those of pretest but for varying environmental conditions.

2.5.4.3 Postbrief. After completing simulator posttests, PARTT-SHIP students were asked to fill out a trainer rating form. The form (Appendix E) asked the rater to evaluate the PARTT-SHIP pre-prototype based on his or her experiences in the areas of:

- Control panel design
- Visual scene
- Hydrodynamics
- Displays (other than visual scene)
- Fidelity
- Utility for training
- Suggested improvements

Section 3

RESULTS

3.1 EXPERIMENT 1: RESTRICTED WATERS

Performance in the area of restricted waters shiphandling was measured by comparing the actual track of ownship to the ordered track. Since all trainees were told to keep their ship on channel centerline at all times, deviations to the left or right of that track were considered errors in performance. Performance was measured by crosstrack distance (CRTD) and alongtrack distance (ALTD) recorded every 5 seconds during test runs. Additionally, during test exercises, the instructor recorded qualitative performance data not otherwise recorded by the computer such as: use of standard terminology in bridge, intraship and intership communications; proper or improper maneuvers in given situations; groundings, etc. Helmsman error was a random error variable. It was assumed that minor variance in helmsman performance was evenly distributed across all groups. Major errors in helmsman performance would have been noted, but did not occur.

Two types of comparisons were conducted, i.e., within groups and between groups. Within groups comparisons were those common to one or more of the groups. All groups were pretested and posttested on the full bridge simulator so that this comparison was common within all groups. Another within groups comparison was pretest and posttest on the PARTT-SHIP. For experimental conditions, all PARTT-SHIP trained groups were pretested and posttested on the PARTT-SHIP. Since control groups did not train or test on the PARTT-SHIP pre-prototype, they did not enter into these comparisons. Within groups comparisons were a form of repeated measures, using the same subjects.

Between groups comparisons consisted of testing mean differences between groups that could be attributed to the effects of various configurations of each device. Between groups for these purposes meant that each experimental and the control group were given a different type of training by virtue of a different training device. It was assumed that the simulator and every different version of the PARTT-SHIP pre-prototype were all separate and distinct training devices, even though in reality they were all similar in many respects. Between groups comparisons were, therefore, those comparisons made between the different treatment groups and the control group, each consisting of different subjects. Figure 1-1 (bottom) illustrates the between group comparisons by device capabilities which were directly related to each separate experimental and control group.

3.2 TRAINING EFFECTIVENESS (WITHIN GROUP COMPARISONS)

Was there a training effect for one day of restricted waters shiphandling training? To answer this question each group of students was tested on the simulator before and after training exercises. Group means are shown in Tables 3-1 and 3-2. These tests were designed to show the presence or absence of training effects for groups trained on the simulator and those trained with the PARTT-SHIP pre-prototype. Most important were the comparisons of simulator and PARTT-SHIP posttest scores.

Two analyses of variance (ANOVA) were conducted using a non-parametric analysis for ranks. Ranked scores were used because the groups were not of equal size and because pretest and posttest scores were related samples. One ANOVA was conducted for CRTD scores and another for ALTD. When considering crosstrack distance (CRTD), results show that simulator pretests, PARTT-SHIP posttests, and simulator posttests are not quantitatively different (Friedman two-way analysis of variance for ranks $X_r^2 = 3.5$, $p = 0.273$). However, when considering total distance traveled, defined as alongtrack distance (ALTD) from beginning to end of scenario, the same comparisons were significant ($X_r^2 = 8$, $p = 0.0092$). This means that a training effect exists when comparing all simulator pretests with PARTT-SHIP and simulator posttest results. Training resulted in longer distances traveled. However, even though students were able to stay in the channel boundaries for longer durations and therefore distances (ALTD), the average distance from center of track (CRTD) did not significantly decrease over training.

<u>Relation of CRTD to ALTD</u>. Each student had an objective of safely maneuvering ownship while keeping as close to the center of the channel as possible. This should have resulted in transits that began and ended at points shown on scenario charts and presented during exercise prebriefings. This meant that the track desired and distance to travel were known objectives and in fact should have been related in results, i.e., good trackkeeping should have resulted in maximum distance (ALTD) traveled in each scenario. This relation was found to be the case only for PARTT-SHIP posttest data and not for simulator pretests or posttests.

Since these two variables were not found to be well related, two different analyses were completed to determine which would be more sensitive to differences among and between groups.

3.2.1 SIMULATOR PRETESTS.

Simulator pretest scores for all groups showed the groups were not significantly different for both CRTD and ALTD (Tables 3-1 and 3-2, respectively). The average of group CRTD pretest performance was 130.7 feet from the center of track with a high of 150.8 feet and a low of 116.7 feet.

TABLE 3-1. AVERAGE DISTANCE FROM CENTER OF TRACK (FEET) (AVERAGE CRTD)

GROUP	SIMULATOR PRETEST	PARTT-SHIP POSTTEST	SIMULATOR POSTTEST
Control	127.0	--	110.5
PS full	150.8	131.6	114.5
PS WOL	135.6	102.0	155.0
PS WOPPI	116.7	97.7	128.0
PS WOCGI	119.5	102.0	115.0
Group Averages	130.7	108.3	128.1

TABLE 3-2. PERCENTAGE COMPLETED OF TOTAL POSSIBLE ALONGTRACK DISTANCE (FEET)

GROUP	SIMULATOR PRETEST	PARTT-SHIP POSTTEST	SIMULATOR POSTTEST
Control	39.8	--	50.5
PS full	53.0	84.0	82.0
PS WOL	43.0	87.8	79.2
PS WOPPI	34.6	97.0	72.0
PS WOCGI	43.4	87.8	87.5
Group Averages	42.8	89.2	74.2

Alongtrack distances were transformed to percentage scores based on the total possible distance that could be traveled in each scenario. The average for all groups pretested on the simulator (Table 3-2) was 42.8 percent completed with a high of 53 percent and a low of 34.6 percent. No significant differences were found between group scores on pretests. Since groups were not significantly different from one another on the pretest, on either measure, then conclusions about training effects could be made without adjustment for entry level skill differences between groups.

3.2.2 PARTT-SHIP POSTTEST (CRTD). PARTT-SHIP pretests were inadvertently made much easier than any other test scenario such that the current effects were less than half of posttests. Additionally, there were many more turns that were much more difficult on posttests than the transit for the PARTT-SHIP pretest scenario. Original TEE planning, however, included comparisons of PARTT-SHIP pretests and posttests along with simulator pretests and posttests. Because PARTT-SHIP pretests were unsuitable for comparison, PARTT-SHIP posttests were compared to simulator pretests since the scenarios were highly similar.

When comparing simulator pretest performance to PARTT-SHIP posttests alone, a consistent and significant decrease in CRTD was found ($X^2 = 5.0$, p 0.05) indicating a training effect for PARTT-SHIP trained groups.

Table 3-2 shows that the average group improvement in crosstrack distance was more than 22 feet, with most improvement occurring for the group trained on the PARTT-SHIP without channel boundaries (WOL) condition. Least improvement was found for the WOCGI group.

3.2.3 SIMULATOR POSTTEST (CRTD). Group improvements were not consistent when comparing simulator pretests and posttests. An average improvement of over 36 feet in trackkeeping error was found for students trained with a fully capable PARTT-SHIP pre-prototype. This improvement was not significant at the p .05 level. All pretest and posttest t-test comparisons for experimental groups (i.e., those students trained on one of the four versions of the PARTT-SHIP pre-prototype) were not significant.

Control groups pretest/posttest performance was not significantly enhanced by training. This finding indicates that this amount of practice alone was not an effective method of training even on a full bridge simulator.

Two of the groups (WOL and WOPPI) showed a drop in performance on simulator posttest but showed gains in performance on PARTT-SHIP posttest (Table 3-1). These drops may represent an interference effect when transferring from the PARTT-SHIP pre-prototype to the simulator.

3.3 COMPARISONS OF DESIGN FEATURES (BETWEEN GROUP COMPARISONS)

Of major importance to the evaluation of the PARTT-SHIP pre-prototype concept is information relating training effectiveness to device features. This was one of the original goals of the TEE. To realize this goal, a set of planned group comparisons were identified in preparations for conduct of pre-prototype evaluation (Hanley et al, 1983). These anticipated comparisons were generated so that major design features of PARTT-SHIP could be examined in terms of their contribution to training. Figures 3-1 and 3-2 show the differences between the versions of PARTT-SHIP for simulator pretest and both posttests.

3.3.1 PARTT-SHIP AND SIMULATOR POSTTESTS (ALTD). Tables 3-3 and 3-4 are an organization of PARTT-SHIP training group means paired for comparison purposes. Paired values in either matrix were used for t-tests representing tests of subsystem effectiveness. Tables 3-3 and 3-4 show the comparisons for training effectiveness based on the performance measure of percent alongtrack distance (ALTD) completed. No comparison was statistically significant at the .05 level.

3.3.2 PARTT-SHIP AND SIMULATOR POSTTESTS (CRTD). Additional comparisons were made of PARTT-SHIP and simulator posttests using the performance measure of crosstrack distance (CRTD). This measure indicated how well the student kept ownship on track from beginning to end of the scenario regardless of the total distance traveled (i.e., ALTD).

PARTT-SHIP Posttests. Table 3-5 shows the t-test results for comparisons of average crosstrack distance maintained throughout PARTT-SHIP posttest scenarios by each group. A significant difference was found for students trained WOPPI when compared to those trained on the full PARTT-SHIP ($t_{(10)} = 3.88$, p 0.02). All other comparisons of PARTT-SHIP posttest performance were not significant.

Simulator Posttests. Table 3-6 shows simulator posttest comparisons. Significant differences were found between groups trained without channel outlines and groups trained WOCGI on the PARTT-SHIP ($t_{(12)} = 2.22$, p 0.05). This finding, that maneuvering without a visual scene (WOCGI) yielded significantly better performance than the WOL group, was unanticipated. Also significant was the comparison of groups trained without channel outlines who performed significantly poorer than those trained on the complete PARTT-SHIP ($t_{(11)} = 2.40$, p 0.05). Control group subjects were also significantly better at maneuvering in the channel than the WOL group ($t_{(11)} = 3.30$, p 0.01). These comparisons underscore the particularly poor performance of the groups trained without channel outlines when posttested on the simulator. This was not consistent with the same groups posttest performance on the PARTT-SHIP. No other group comparisons were statistically significant for simulator posttest performance.

TABLE 3-3. AVERAGE PERCENT ALONGTRACK DISTANCE COMPLETED ON PARTT-SHIP POSTTEST

GROUP	WO CGI	WO PPI	WO LINES	FULL
WOCGI	--	97.0 87.8	87.8 87.8	84.0 87.8
WOPPI	--	--	87.8 97.0	84.0 97.0
WOL	--	--	--	84.0 87.8

*Significant at $p < 0.05$

TABLE 3-4. AVERAGE PERCENT ALONGTRACK DISTANCE COMPLETED ON SIMULATOR POSTTESTS

GROUP	WO CGI	WO PPI	WO LINES	FULL
WOCGI	--	72.0 87.5	79.2 87.5	82.0 87.5
WOPPI	--	--	79.2 72.0	82.0 72.0
WOL	--	--	--	82.0 79.2

*Significant at $p < 0.05$

TABLE 3-5. AVERAGE CROSSTRACK DISTANCE ON PARTT-SHIP POSTTEST

GROUP	WO CGI	WO PPI	WO LINES	FULL
WOCGI	--	97.7 102.0	102.0 102.0	131.6 102.0
WOPPI	--	--	102.0 97.7	131.6 * 97.7
WOL	--	--	--	131.6 102.0

*Significant at $p < 0.05$

TABLE 3-6. AVERAGE CROSSTRACK DISTANCE ON SIMULATOR POSTTESTS

GROUP	WO CGI	WO PPI	WO LINES	FULL	CONTROL
WOCGI	--	128.0 115.0	155.0 * 115.0	114.5 115.0	110.5 115.0
WOPPI	--	--	155.0 128.0	114.5 128.0	110.5 128.0
WOL	--	--	--	114.5 * 155.0	110.5 * 155.0
FULL	--	--	--	--	110.5 114.5

*Significant at $p < 0.05$

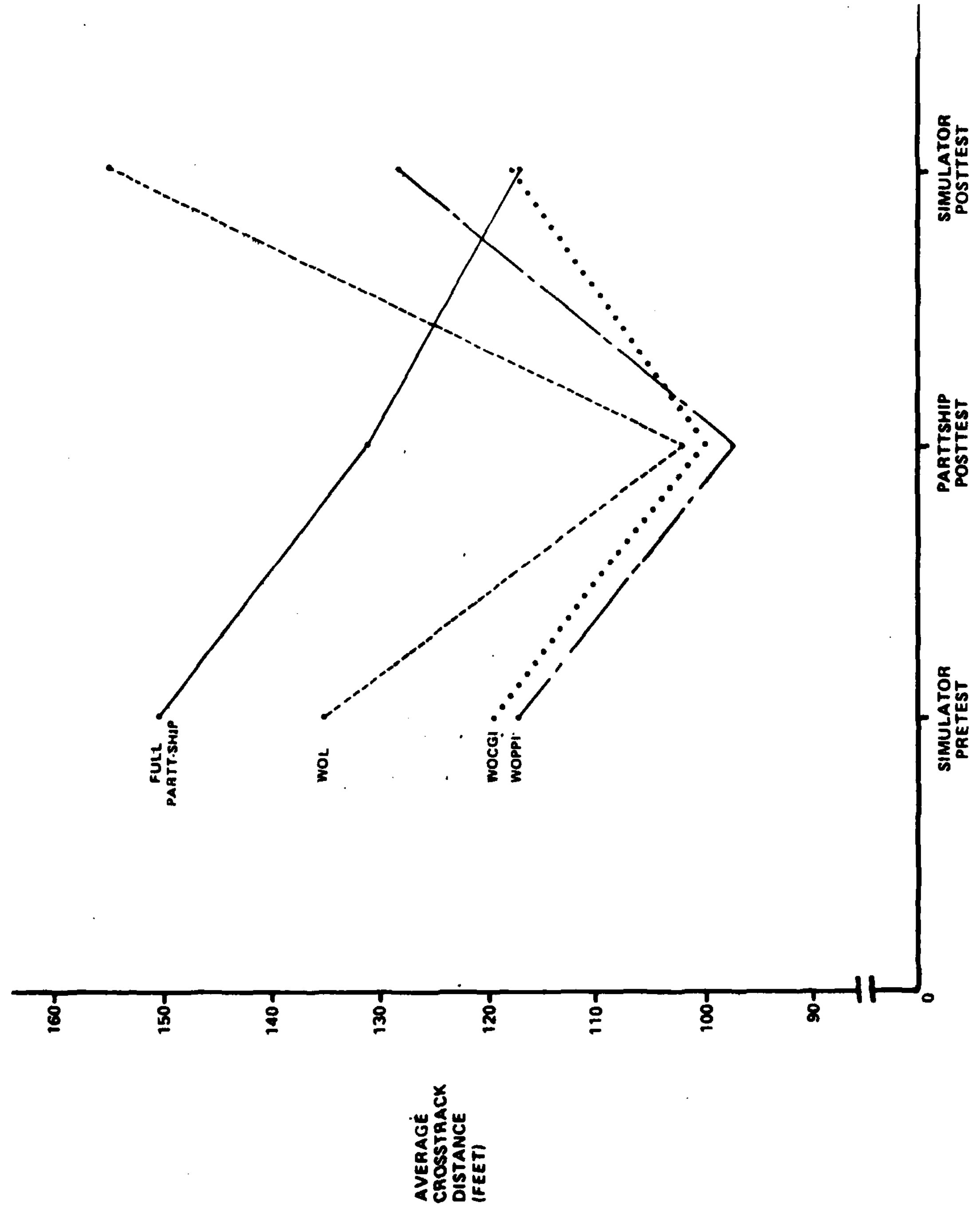

Figure 3-1. Average Crosstrack Distance (in feet) for Pretests and Posttests

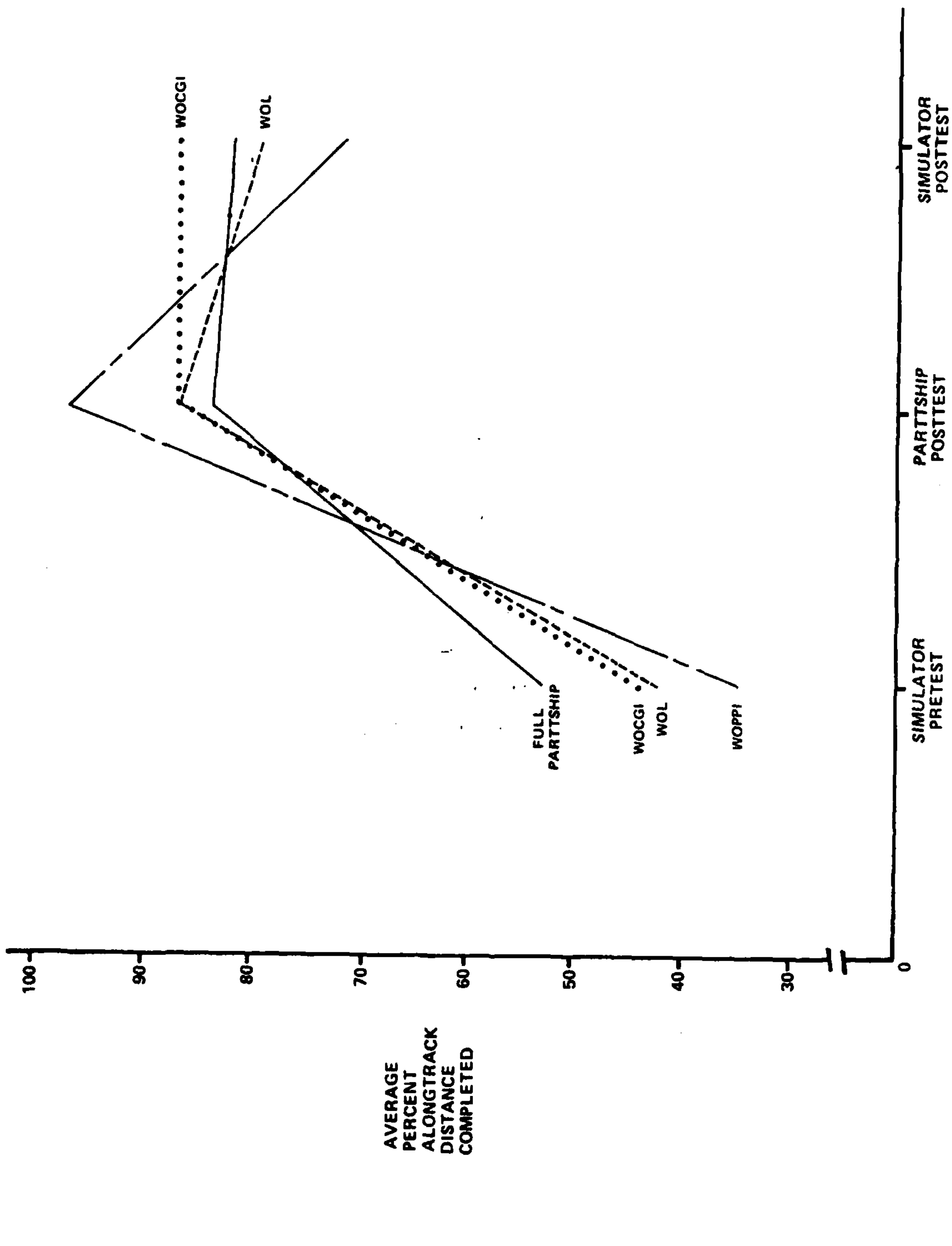

Figure 3-2. Percent Alongtrack Distance Completed for Pretests and Posttests

Section 4

EXPERIMENT 1 DISCUSSION

The two primary goals of the TEE were to: (1) demonstrate training effectiveness of the PARTT-SHIP when compared to the full bridge simulator, and (2) compare the relative effectiveness of various design features of the PARTT-SHIP pre-prototype.

As to the first goal, training effectiveness of PARTT-SHIP was operationally defined as training effects not significantly different from those found for full bridge simulator training. The experiment sought to answer the questions of whether PARTT-SHIP training was the same, better, or worse than full bridge simulation training. Results indicate that the answer to the questions of training effectiveness appears to vary based on the dependent measure chosen for comparisons

Did the PARTT-SHIP demonstrate an acceptable level of training effectiveness for restricted waters scenarios? The answer is a qualified yes, which is explained in more detail within following discussions. The PARTT-SHIP, in one of its four configurations, was at least as effective as the full bridge simulator. In several cases PARTT-SHIP was more effective. The fact that full bridge training was never found to be significantly more effective than the PARTT-SHIP signifies a similarity in training capability between devices. This result was consistent across posttest conditions and was reliable for both CRTD and ALTD (Figures 3-1 and 3-2).

Were the variations in PARTT-SHIP configurations significantly different from one another? The answer to the question of relative training effectiveness between the four versions of PARTT-SHIP is somewhat more complicated than that of training effectiveness of the PARTT-SHIP compared to the full bridge. Again the answer is a qualified yes, depending on the performance measure used.

4.1 PARTT-SHIP POSTTESTS

Students were better at staying on track when trained with a PARTT-SHIP pre-prototype that did not include both a CGI and a PPI subsystem. This meant that students learned more when either just a visual scene was available, or just a PPI display was available during training. This was an unexpected finding since it was previously assumed that more, rather than less, information would be beneficial to training.

When being posttested on the PARTT-SHIP the trainee had the option to use visual scene information or PPI information to see where the ship had been, where it was at present, and plan its future movement. It was assumed that performance would be improved as the number of sources of information increased, thereby allowing the student to improve his or her understanding of the shiphandling problem. Improved performance did not occur.

An explanation of this unanticipated effect is possible by examining the previous training history of students. Only some of the students had any substantial at-sea experience, while all students had extensive radar scope training. This may have biased students to use familiar information processing and management strategies when being tested, to the detriment of effectively integrating visual and radar information.

An alternative explanation of this finding comes from experiments conducted by the U.S. Coast Guard. Multer and Smith (1983) examined performance of pilots when radar piloting, visual piloting, and when using both sources of information. Findings from that experiment suggest that pilots switched strategies for use of visual and radar information depending on visibility. Pilots appear to be capable of good piloting with either source of information but prefer visual scene when available. Subjects in this experiment, however, were not experienced in using visual piloting data for transits. It is quite possible that in situations where visual information was the best source of information, students perseverated in using radar displays. Indeed, on several occasions, while students were feverishly plotting on maneuvering boards and scope heads, a buoy was run over while all the time being clearly visible and dead ahead of the ship.

The control group's performance on the simulator posttest was significantly better than the WOL group, however, both groups trained without channel outlines on their PPI displays. Then why were the control group subjects so much better? The answer may be that the PPI display on the simulator, used by control subjects, was a good plotting surface, while the PARTT-SHIP PPI/situation display did not afford a plotting surface. This means that the control group had an advantage, since they could generate scope head versions of piloting and navigation plots.

Except for the Complete PARTT-SHIP groups, scores on the PARTT-SHIP posttest were generally better than those on simulator posttests. This result was unanticipated. It would be logical to hypothesize that posttests on PARTT-SHIP were generally better than simulator posttests because the test and training were accomplished in the same context, and therefore, did not require a shift from the training environment to a less familiar test environment. However, a more likely explanation was that the reduced effect of current on PARTT-SHIP posttest scenarios (2 knots) compared to simulator posttests (4+ knots) accounts for this difference. (It was necessary to vary current effects to show how adaptive training was in handling various environmental conditions.) Both lower difficulty of the scenario, through reduced current effects, and no change in context for the test, could have aided performance on these tests. Switching from the smaller bridge of PARTT-SHIP to full bridge simulator probably caused at least a minor performance deficit. This could have happened because of minor visual scene

differences and large differences in size and types of bridge controls. PARTT-SHIP CRT displays were somewhat clearer since CRTs have generally better image definition than rear projection systems similar to that used with the full bridge simulator.

4.2 SIMULATOR POSTTESTS

The most significant effects for simulator posttests were; the difference between control group performance and the WOL group, and complete PARTT-SHIP CRTD performance results compared to the WOL group. Both of these comparisons suggest a strong influence on performance from the presence or absence of channel outlines during training.

Performance was generally poorer on simulator posttest versus PARTT-SHIP posttest but it is difficult to account for why the WOL group performance sharply decreased from one type of posttest to the other. It is possible that the WOL group suffered interference effects when transitioning from the PARTT-SHIP context to the simulator similar to that described by Williams, Goldberg, and D'Amico (1980). However, this effect was not noted in other experimental groups.

No interference effect from shifting between PARTT-SHIP and the simulator was noted for the measure of alongtrack distance. Little difference was noted between PARTT-SHIP posttest and simulator posttest for the WOL groups. However, a large drop was noted for the WOPPI group when transitioning from PARTT-SHIP to the simulator. This could have also been attributed to; context shift interference from one device to another, the clarity of the visual scene that was of higher quality on the PARTT-SHIP pre-prototype, or the fact that students attempted to implement plotting techniques, not used during training without a PPI.

4.3 SUMMARY

It can be concluded that the PARTT-SHIP pre-prototype was as training effective as the full bridge simulator used in this experiment. In most cases, performance of groups trained on the PARTT-SHIP device was better when posttested on the PARTT-SHIP pre-prototype than when posttested on the simulator. Except for the WOL group, PARTT-SHIP trained groups were equivalent to the control group trained on the simulator. This answers the question of relative training effectiveness between the PARTT-SHIP pre-prototype and the simulator. However, statistically significant differences between versions of the PARTT-SHIP were not clearly established. The one exception to that finding was the WOL group trained on PARTT-SHIP. This finding supports the suggestion of large effects for special displays when used to enhance training.

A question which remains unanswered was whether either device is a valid training device in terms of increased on-the-job skills. Although these two trainers were found to be equivalent, they were found to be so without any generalization of what the effects of this training would be in schools for shiphandling, e.g., SWOS, or for performance as a conning officer on a real ship.

It should also be noted that all training occurred in the span of 4 to 5 hours. The rest of the time spent during an experimental day was given to the mechanics of experimentation such as familiarization, warm-ups, lunch, etc. This one day of training may not have been a reliable test of the PARTT-SHIP device's overall potential when used as part of formal training programs for all levels of shiphandlers. Even though positive training effects were found for this relatively short period of training time, it is expected that much greater gains would be made in 2 to 3 days of training. Use of a simulator was a new experience for virtually all of these trainees. Increased time on either the PARTT-SHIP or full-bridge simulator would allow trainees to become more familiar with both the operation of the devices and the various cues presented by the devices.

Section 5

RESULTS

5.1 EXPERIMENT 2: COLLISION AVOIDANCE

Results are divided into those for CPA (closest point of approach) and range of maneuver. These two measures are logically related. Maneuvering early to avoid collision can increase CPA, while lack of understanding may lead to no maneuver resulting in close CPAs. These are not always the results, however, when interpreting the rules of the road, but early and substantial action is a good rule of thumb for giveway situations. When encountering stand-on situations or combinations of stand-on and giveway, the proper action is not so easily evaluated or measured.

5.2 TRAINING EFFECTIVENESS (WITHIN GROUP COMPARISON)

To address the issue of training effectiveness, beginning skill levels as measured on pretests were compared to posttest results. Posttests measured increases in student competence at the end of one training day.

5.2.1 PARTT-SHIP AND CONTROL GROUP POSTTESTS (CPA). A comparison of group means is shown in Figure 5-1. Each score in Table 5-1 represents the average percent of the optimum solution attained, e.g., on simulator pretests an optimum CPA of 5,000 yards was determined by the instructor as the solution that most satisfied the objectives of that scenario. All individual scores were transformed to ratio scores and then compared by means of planned correlated t-tests for within groups (pretests and posttests) and independent t-tests for between groups comparisons.

It can be seen that an average increase of 77 percent in CPA was attained between simulator pretests and posttests for students trained on the PARTT-SHIP ($t_{(8)} = 2.17$, p 0.05, one tailed). Although this was a large increase, even more impressive was a similar but larger training gain realized for the same group as measured by PARTT-SHIP posttests. As shown in Table 5-1, an average gain of more than 123 percent was found which was a statistically significant increase ($t_{(7)} = 2.18$, p 0.05, one tailed). Such results are encouraging since variability within groups was rather high, making t-test results conservative estimates of actual group differences. Table 5-1 contains means and standard deviations to show the great variability within these sets of comparisons.

Control group results show similar increases in CPA of over 100 percent. This gain was, however, not statistically significant because of the high variability within pretests and posttests.

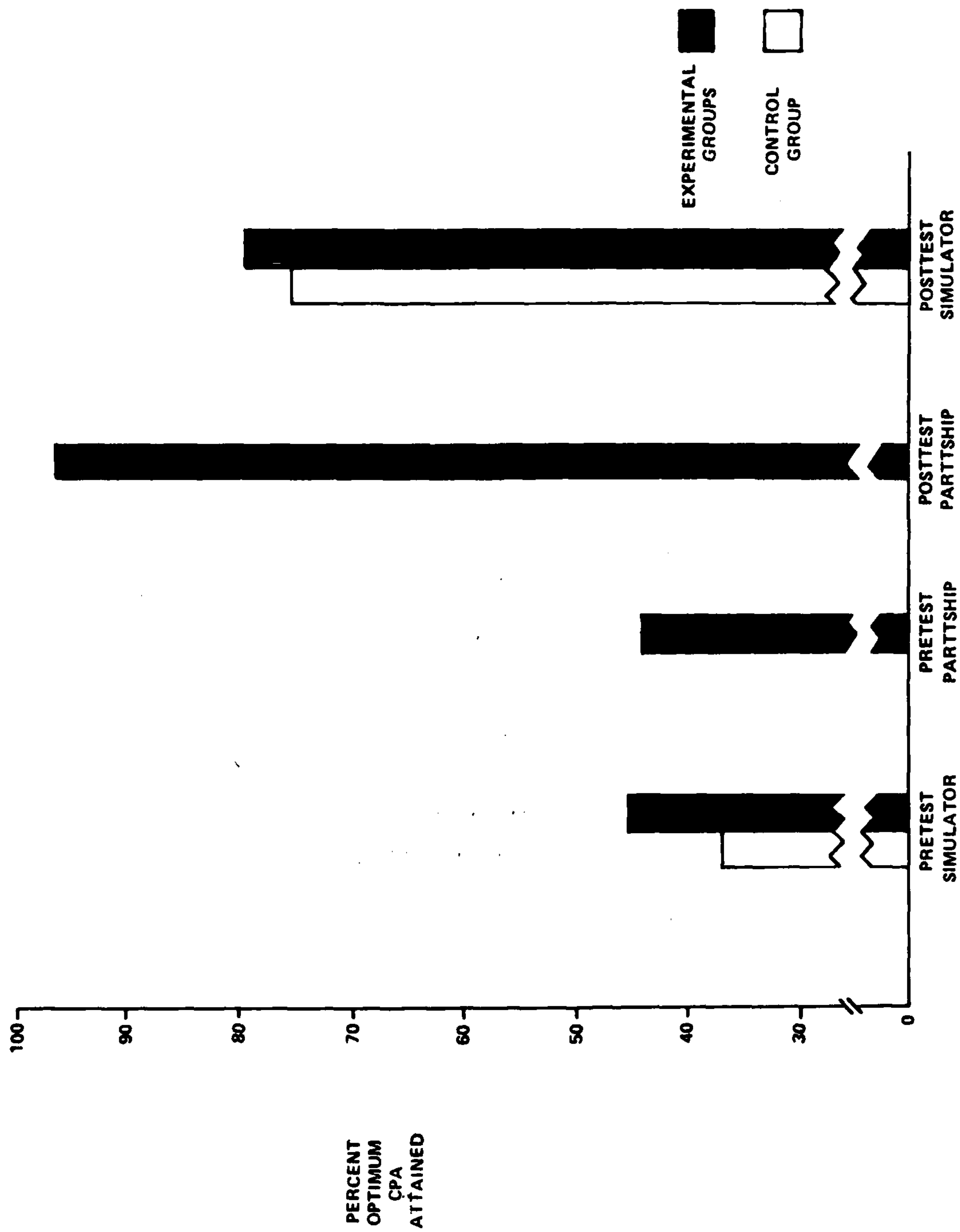

Figure 5-1. Percent of Optimum CPA Attained

TABLE 5-1. PRETEST-POSTTEST RESULTS FOR EXPERIMENTAL AND CONTROL GROUPS BY TYPE OF DEVICE FOR PERCENT OPTIMUM CPA ATTAINED (PERCENT)

Test	Simulator		PARTT-SHIP
	Control	Experimental	Experimental
	Mean/S.D.	Mean/S.D.	Mean/S.D.
Pretest	37.7/27.4	44.8/25.7	43.2/26.7
Posttest	75.7/66.1	79.4/32.7	96.6/90.6
Change (Δ)	38.0	34.6	53.4
Percent increase	100.8	77.2*	123.6*

*Significant at $p < 0.05$

TABLE 5-2. PRETEST-POSTTEST RESULTS FOR EXPERIMENTAL AND CONTROL GROUPS BY TYPE OF DEVICE FOR RANGE OF MANEUVER (N.M.)

Test	Simulator		PARTT-SHIP
	Control	Experimental	Experimental
Pretest	1.46	1.17	2.86
Posttest	1.63	0.84	* 2.18
Change (Δ)	0.17	-0.33	-0.68
Percent increase	12.00	-28.00	-23.7

*Significant at $p < 0.05$

5.2.2 PARTT-SHIP AND SIMULATOR POSTTESTS (RANGE TO MANEUVER). Closest point of approach (CPA) is a summary and sometimes crude estimate of collision avoidance behaviors. This is because collision avoidance is a form of decision-making and problem solving and as such requires a more in-depth* assessment of performance than just measuring CPA alone. In an attempt to improve on performance measurement in this area, the range of initial maneuver was recorded in each scenario.

Problems with this measure are several in that its meaning changes with regard to context, i.e., the scenario geometry of ownship and traffic vessels. All scenarios used in this experiment were crossing situations. As with CPA, the optimum solution to the training exercise was calculated by the instructor based on training objectives. This solution was used as a basis for assessing student solutions in terms of proper or improper applications of the International Rules of the Road.

Table 5-2 shows the means of each group involved in collision avoidance training for range of maneuver. In this context, range of maneuver means the distance from the contact posing a threat of collision at the time ownship takes action. The results are mixed, as shown in Figure 5-2, showing a slight increase in performance for control groups and a somewhat greater decrement in performance for experimental groups. All increases and decreases are statistically nonsignificant but for the difference between posttest on simulator and posttest on PARTT-SHIP for the experimental group. A correlated test of matched pairs shows that the same group (experimental) performed better on PARTT-SHIP than the simulator ($t_{(7)} = 2.91$, p 0.05, two tailed). This difference was not predicted and is difficult to account for given associated pretest results in Table 5-2. Differences in scenarios would account for some of this difference. Appendix A shows Training Scenario 14 (TS-14) which was used for simulator posttests and PARTT-SHIP posttest TS-4. These scenarios are both high in difficulty but TS-14 greatly limits how the student can act under the rules of the road.

No difference was found between groups for increases in appropriate maneuvers on posttest compared to pretest.

*CPA is a measure that is rather summary in nature. It doesn't explain why students come as close to traffic vessels as they do. Range of maneuver is "more in-depth."

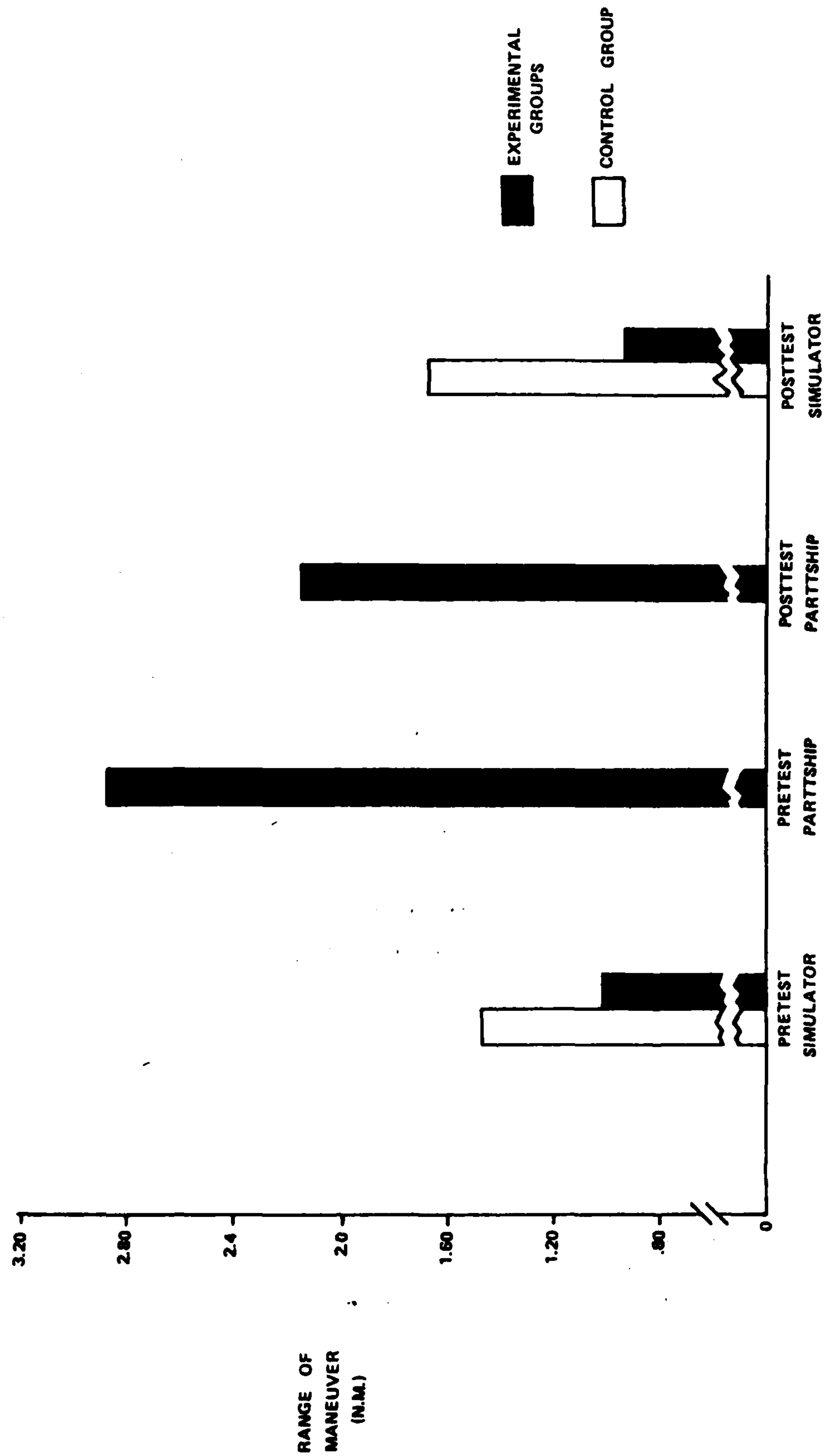

Figure 5-2. Range of Maneuver (NM)

Section 6

EXPERIMENT 2

DISCUSSION

Of the two areas trained and tested as part of the PARTT-SHIP/simulator TEE (restricted waters and collision avoidance), the collision avoidance area was more straightforward for purposes of interpretation based on CPA. PARTT-SHIP trained groups were consistently high performers on posttests and accounted for the largest training gains within this second experiment. In terms of training effectiveness, the part-task trainer was at least as effective as the simulator for this area of rules of the road collision avoidance training, and in most cases more effective. Results clearly establish the PARTT-SHIP pre-prototype as having high effectiveness for these rules of the road scenarios and as having high positive potential for use as a total rules of the road trainer. However, it should be noted that only head-on and crossing situations were trained and evaluated. Generalizing these findings to all other areas of rules of the road training will have to wait for further research with such situations; generality in these terms is an empirical issue.

When considering range to maneuver, few differences between groups were significant or in the expected direction. What is most surprising about results based on the range of maneuver measure is that each student was specifically instructed to maintain plots on all contacts and to correlate visual and radar contacts (Appendix D, Commanding Officer Standing Orders for Training Exercises), but some contacts reached close aboard CPAs. Early and substantial action was continually stressed to all students, yet no average increases in range of maneuver was found for PARTT-SHIP trained groups. Only simulator trained (control) students increased average range to maneuver. These results may indicate a need for a PARTT-SHIP PPI that affords a plotting surface. The PARTT-SHIP PPI/situation display is a CRT without plotting overlay material. The need for such a design change was similarly suggested based on results from Experiment 1 (Section 4) that suggested a similar simulator advantage. Since students had extensive scope-head plotting experience, it is reasonable to assume that performance would have been enhanced for control groups who could take advantage of that experience.

It is clear that the CPA measure distinguished good from poor performance better than the range to maneuver measure. In a relative sense, pretest to posttest comparisons were statistically significant. However, when considering the training objectives in view of type of maneuver and the fact that no increases in appropriate actions were found, the amount of training given was probably not enough to adequately change behavior to meet the goal of early and substantial action to avoid collisions.

Section 7

SUBJECTIVE TRAINING EFFECTIVENESS EVALUATION

A survey (Appendix E) was constructed to collect all of the opinions from trainees and users of the PARTT-SHIP pre-prototype concerning its training effectiveness and potential. Each respondent was asked to answer all or a portion of the 23 different items based on his or her individual experience. Items were grouped into six different areas covering the design and use of the pre-prototype. The following is a description of the summary results for those ratings based on the responses of 6 advanced officers and 33 junior officers that have been trained on the device. Results are summarized in Table 7-1.

7.1 CONTROL PANEL

These subjective results indicate a general satisfaction with control panel design including the operation, readability, placement and completeness of the design.

7.2 VISUAL SCENE

For the visual scene, raters appeared satisfied with the field of view (153 degrees) in the horizontal plane and the clarity or resolution of the scene. The detail of the scene, however, was rated somewhat lower indicating that both senior and junior officers believed that, of the three dimensions rated, detail of scene could stand the most improvement. Additionally, the majority of respondents (24 of 36) believe that the visual subsystem was the most important of the subsystems modeled within the PARTT-SHIP.

7.3 HYDRODYNAMICS

The portion of the survey dealing with hydrodynamics had to do with the handling characteristics of the ship and the environmental effects of wind and current. Because of the prerequisite for a modicum of shiphandling experience to answer these questions, only senior officers responses were scored. The range of responses (Table 7-1) indicates approval of the ship and environmental effects pre-prototype.

7.4 DISPLAYS

Of all of the subsystems rated, displays were rated consistently highest by senior officers. Junior officers rated most displays as high in value but with some variability. This lack of agreement between senior and junior officers in some instances can be attributed to the differential amounts of experience each group had with the device. Junior officers, having trained on the device for a day, were more apt to have a substantial basis for evaluating these displays. Of the four types of displays (i.e., predictor,

TABLE 7-1. SUMMARY OF PARTT-SHIP OPINION SURVEY

Survey Area	Rating	
	Senior Officers	Junior Officers
A. Control Panels		
Completeness	4.5	4.8
Operation	4.1	4.3
Readability	4.2	4.2
Placement	4.3	4.3
B. Visual Scene		
Field of view	4.2	4.4
Clarity	4.0	4.3
Detail of scene	3.7	4.1
C. Hydrodynamics (Senior Officers Only)		
Wind and current	4.0	--
General ship response	4.5	--
Ship turning acceleration	4.5	--
Tugs and anchors	4.3	--
D. Displays		
Predictor	4.8	3.3
History	4.8	3.9
Situation	4.8	4.7
Feedback	4.8	4.8
E. Fidelity		
For training	4.2	5.3
Necessary "real world" objects	4.3	4.2
Buoys/ships/cultural objects	3.7	4.2
F. Utility of Design		
Current design for basic officers	4.7	4.8
Most important subsystem	Visual	Visual
G. Suggestions		
Improve rudder/helm controls (n=12)		
Improve bearing cursor joystick (n=2)		
Improve autopilot (n=2)		
Add a visual bearing capability (n=2)		
Upgrade for team training (n=2)		
Add a daytime land capability (n=2)		

TABLE 7-1. SUMMARY OF PARTT-SHIP OPINION SURVEY (CONTINUED)

Rating Scale for Agreement/Disgareement
With Statements for Appendix E

5 = Complete agreement
4 = More than moderate but not complete agreement
3 = Moderate agreement
2 = Less than moderate agreement, but not complete disagreement
1 = Disagree

history, situation, and feedback) feedback displays were rated highest while predictor displays were rated the lowest. However, all displays were rated on the high end of the five-point scale. This indicates that, for junior officers, feedback and situation displays provided more utility than history or predictor displays; but all were considered quite valuable.

7.5 FIDELITY

The fidelity of the device, that is, how the real world is modeled within the PARTT-SHIP cubicle was rated rather highly. This is most probably attributed to the night scenes which are quite lifelike. The lowest ratings for fidelity were those for buoys, ships, and cultural objects. These were modeled as low fidelity representations of real world objects during day scenes. Nevertheless, both senior and junior officers rated the fidelity of the trainer as high.

7.6 UTILITY

The last two sections of the rating questionnaire requested that the rater comment on the utility of the existing design and suggest improvements. Both senior and junior officers gave their highest ratings for the item asking whether the device, in its current configuration, would be a good means for training shiphandling principles and concepts to Navy officers who have not already become accomplished shiphandlers. Their combined responses clearly indicate that the people that have seen the device believe it has utility as a shiphandling training device.

7.7 IMPROVEMENTS

The last section of the questionnaire asks the rater to suggest improvements to various subsystems that would increase the effectiveness of the existing design. Although many of the respondents did not suggest improvements, for those responding (n=22), the majority (N=12) suggested that the existing rudder, helm controls, and indicators be remodeled for easier operation. Other suggested improvements, by a small fraction of respondents, were: improving operation of the bearing cursor on the PPI display (n=2), improving the design and operation of the autopilot (n=2), adding a visual bearing capability (n=2), upgrading the trainer for use in team training (N=2), and adding a daytime land simulation capability (n=2).

7.8 SUMMARY

When considering all of the ratings for the various subsystems of the PARTT-SHIP device, it can be seen that those who witnessed demonstrations of the device and actually trained on the device, believe that the PARTT-SHIP pre-prototype is a valuable and well designed part-task training device for shiphandling concepts and

principles. Of the improvements suggested by the respondents, two of these were anticipated after the final construction of the device in the factory (i.e., improvement of the rudder and helm controls and the capability for taking visual bearings). These were the most noted of all deficiencies within the existing design. Neither of these improvements constitute a costly design change and can be inexpensively incorporated into the existing design.

Several other design changes were identified as desirable to improve PARTT-SHIP use.

a. A plotting surface, overlaid upon the PPI/situation display, would greatly enhance plotting functions. As mentioned in experimental discussions, the lack of this capability may account for lowered scores in collision avoidance and restricted waters training groups. A non-glare glass plotting surface is indicated. Adding an actual radar would also solve this problem, but at high cost.

b. Helm control should include larger gauges with more realistic scales. The circular mechanical meter should replace the edge meters currently used.

c. Many spoken comments were made during training concerning the need to upgrade the visual scene in terms of adding: higher fidelity during daytime scenes, landmass simulation, and a wider field of view for using abeam information.

d. Although the PPI/situation display provided bearing information, a visual bearing was not possible given the existing design, without correlating radar-like information with a very rough visual bearing. A CGI bearing cursor, in the visual scene, or a mechanical pelorus is necessary to allow visual bearing taking.

e. A more positive indication of autopilot engagement is desired. Several users were confused at the non-responsiveness of the manual helm only to find that the autopilot was engaged. Additionally, the locations of manual and autopilot helm controls should be changed to physically separate these control functions.

f. The particular joystick mechanism used on the PPI/situation display should be upgraded to a smoother, easier to control mechanism. Especially in the larger range scales, moving the cursor onto the displayed contact was quite difficult.

Section 8

SUMMARY

PARTT-SHIP has been found to be an effective device for the training areas of collision avoidance and maneuvering in restricted waters. It was at least as effective as the full mission shiphandling trainer to which it was compared.

Many additional questions exist concerning its application, but the basic design appears to be sound as examined in the quantitative and qualitative TEE. Some deficiencies in design appeared to be helm controls and the capability to take a visual bearing. Neither of these features poses a significant effort for redesign in terms of cost or time.

Apart from the effectiveness of the pre-prototype, much remains to be learned concerning the processes involved in shiphandling skill acquisition. The results of these experiments suggest that all shiphandlers do not use visual scene and radar information in the same manner. It is quite likely that novice shiphandlers go through stages of learning to learn shiphandling skill. The first stage may well be learning the concepts involved when acquiring shiphandling skills. Without this prerequisite knowledge, little or no learning would likely occur. This may account for why special training displays, like channel outlines, had such powerful effects on pretest and training exercises.

A major step to be taken for PARTT-SHIP is the application of the device in its fully specified form. Also lacking is evidence that PARTT-SHIP can be effective as part of an ongoing shiphandling training program. Results of these experiments support its utility in a shiphandling basic level course, but do not answer questions of its actual use in 3- to 5-day training courses in shiphandling.

Since PARTT-SHIP uses a low fidelity visual scene for cost considerations, it is unlikely that evolutions like UNREP can be adequately modeled, especially in daytime scenes. Upgrading of the CGI system, to be capable of such pre-prototyping in a test pre-prototype version like the existing PARTT-SHIP pre-prototype, could add much valuable information to the question of fidelity versus training effectiveness.

Experimentation should expand beyond collision avoidance and restricted waters training to other important areas, e.g., docking, mooring, UNREP, anchor use, etc. Further experimentation is necessary because application of the device would necessarily vary depending on its demonstrated usefulness in all areas of shiphandling.

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2. J.W. Gynther, T.J. Hammell, and J.A. Grasso. "The U.S. Coast Guard's Prototype Shiphandling Simulator-Based Training Program for Rules-of-the-Road. Department of Transportation, U.S. Coast Guard Office of Personnel, Washington, D.C., Contract No. DOT-CG-835285-A (Mod 6), 1981.

3. T.J. Hammell, J.W. Gynther, J.A. Grasso, and M.E. Gaffney. "Simulators for Mariner Training and Licensing Phase 2: Investigation of Simulator Characteristics for Training Senior Mariners." U.S. Coast Guard and U.S. Maritime Administration Technical Report CAORF 50-7915-02, October 1981.

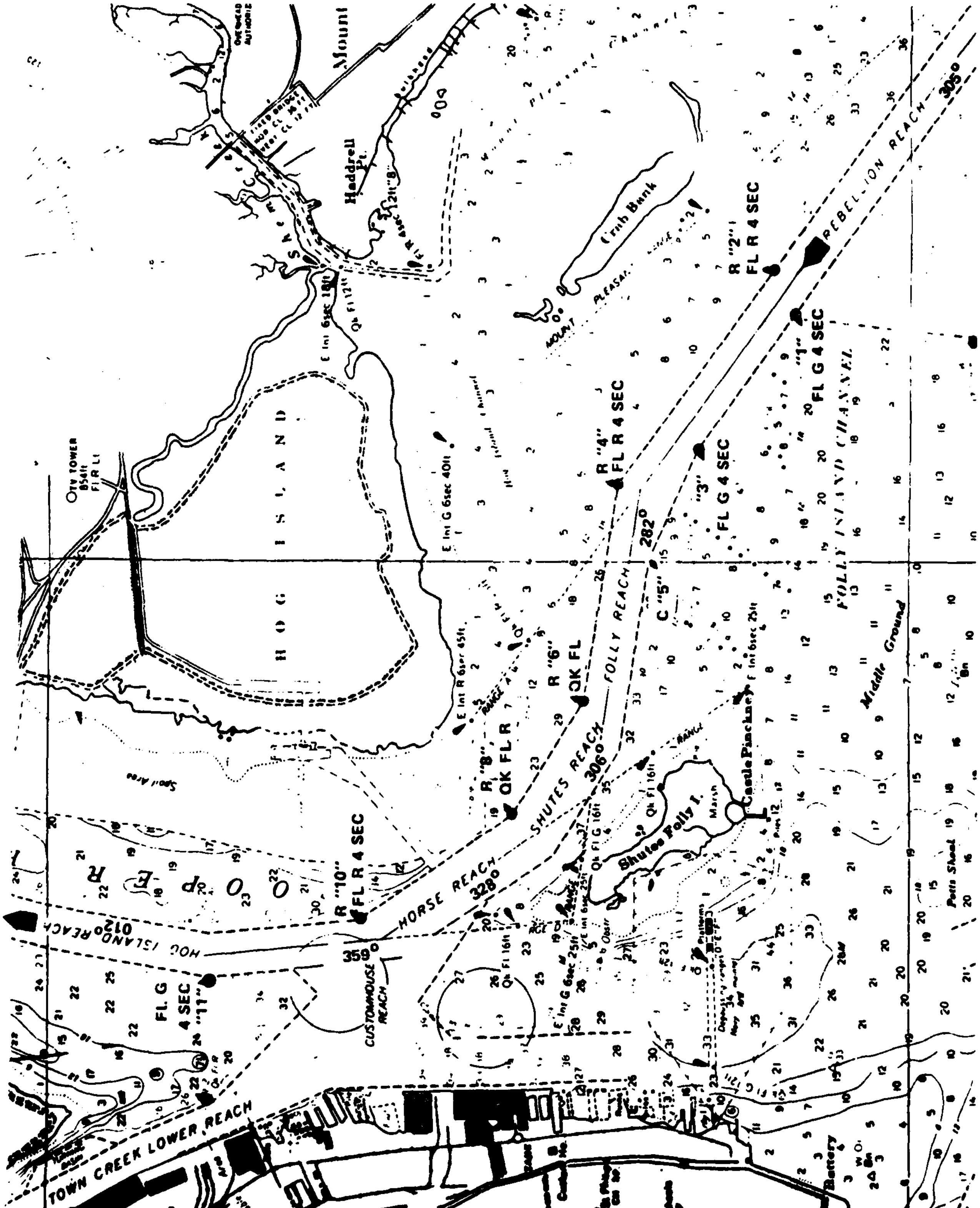
4. M.J. Hanley, W.R. Bertsche, and T.J. Hammell. "Naval Shiphandling Study." Report No. EA-82-U005, Human Factors Research Laboratory, Naval Training Equipment Center, Orlando, Florida, 1982.

5. J. Multer and M.W. Smith. "Aids to Navigation Radar I Principal Findings: Performance in Limited Visibility and Short Range Aids With Passive Reflectors." U.S. Coast Guard, Office of Research and Development, Department of Transportation, 83-U-143, 1983.

6. K.E. Williams, J. Goldberg, and A. D'Amico. "Transfer of Training from Low to High Fidelity Simulators." CAORF 50-7919-02, Office of Research and Development, Maritime Research Center, Kings Point, New York, 1980.

APPENDIX A

TRAINING SCENARIOS



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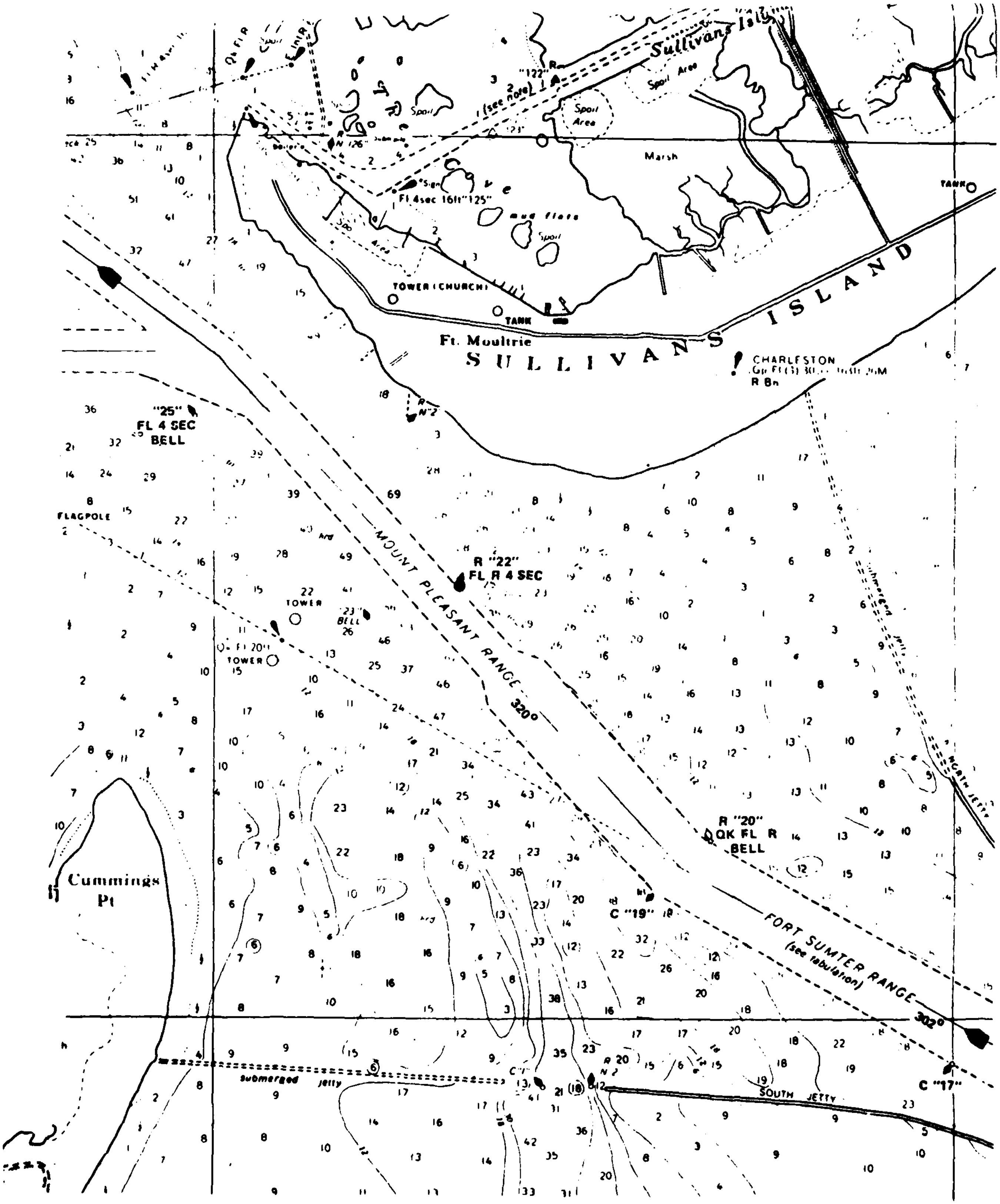

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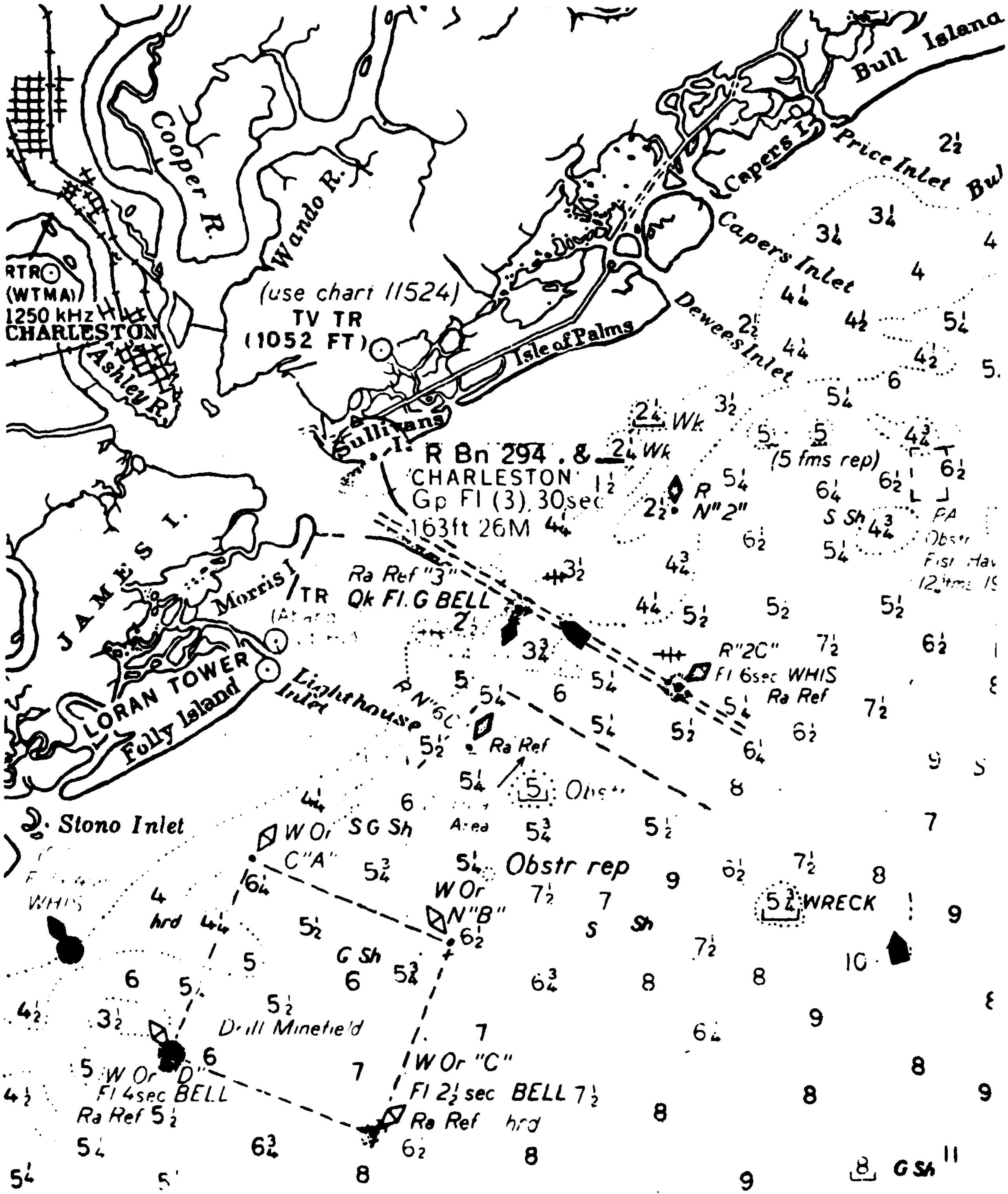

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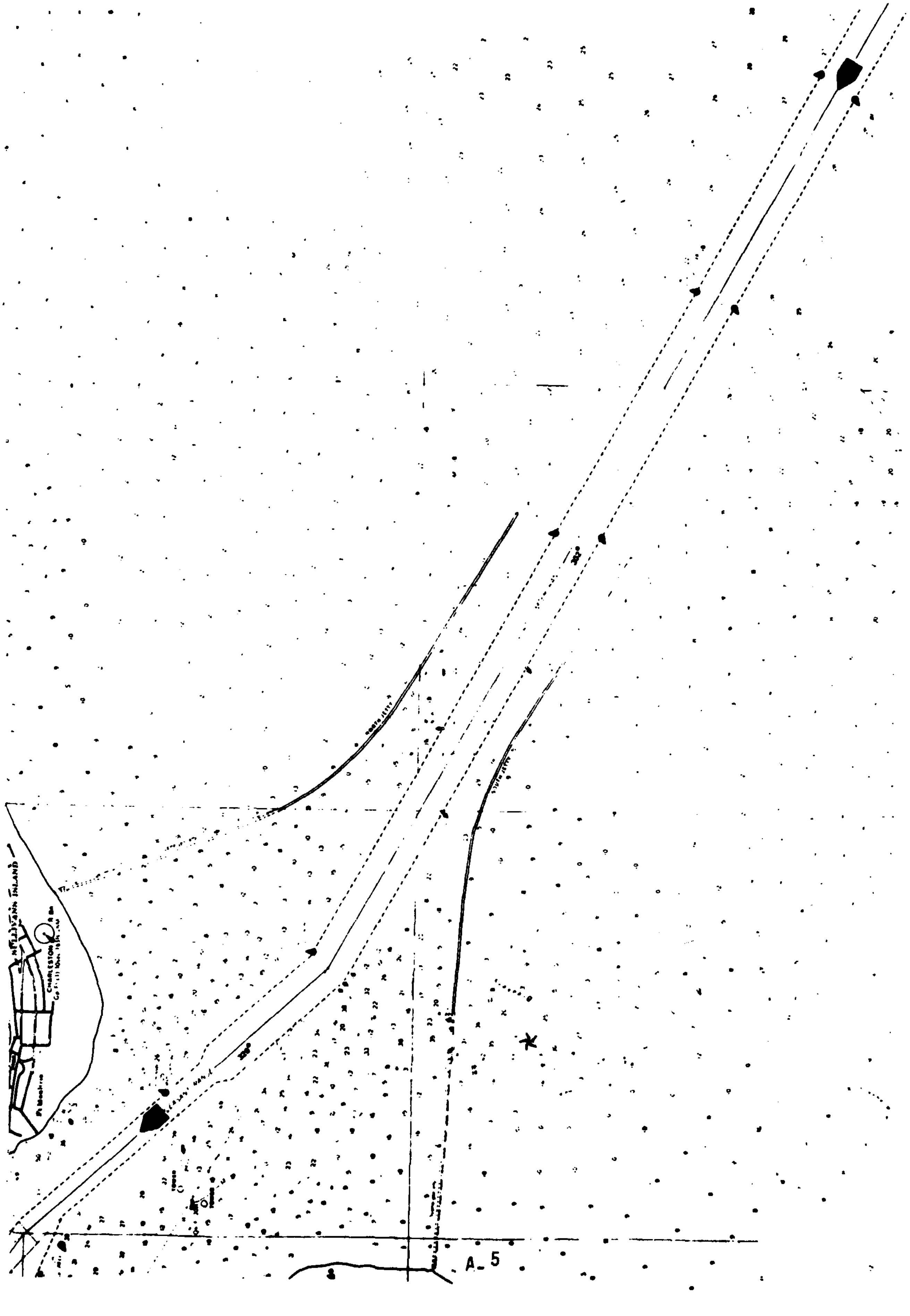

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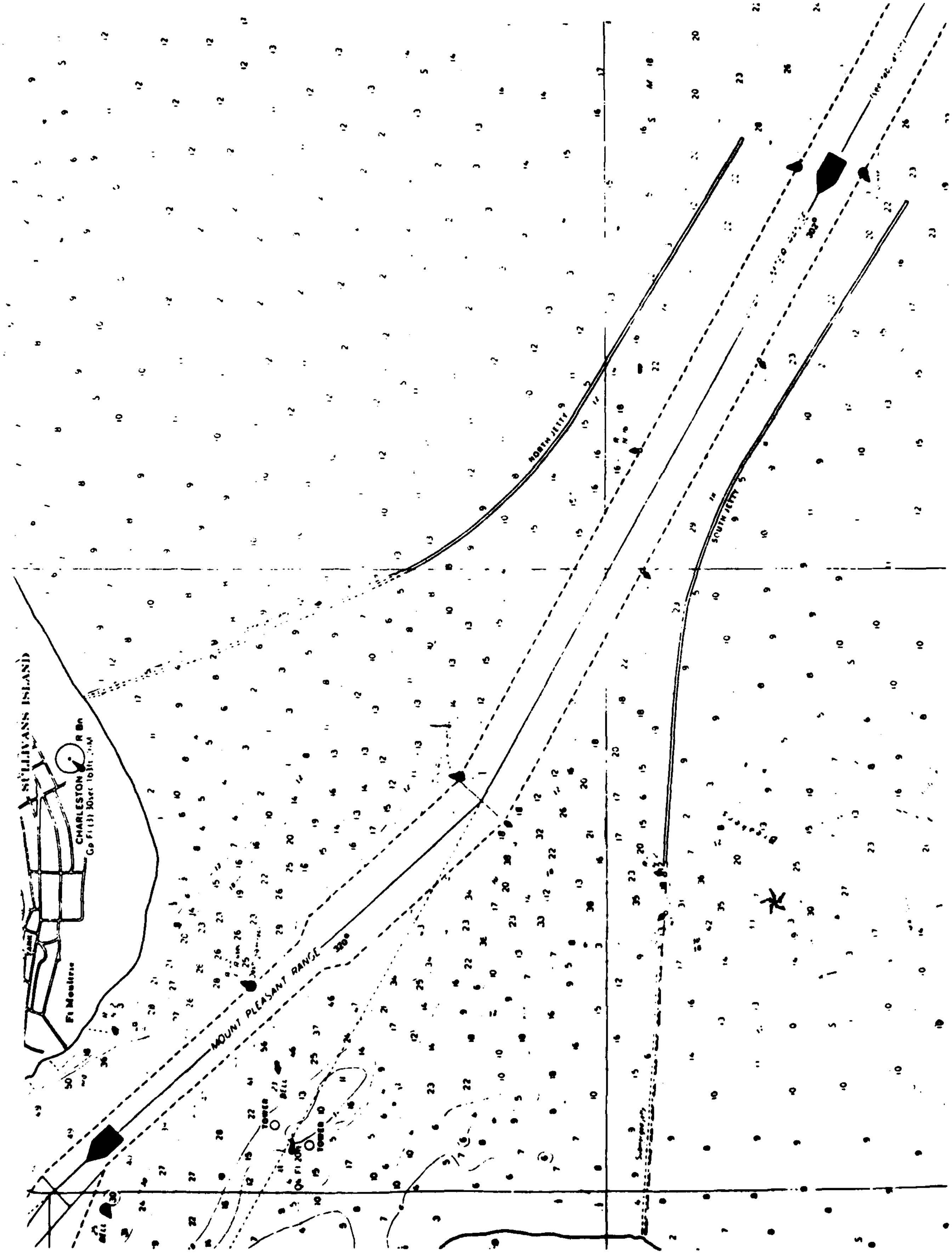

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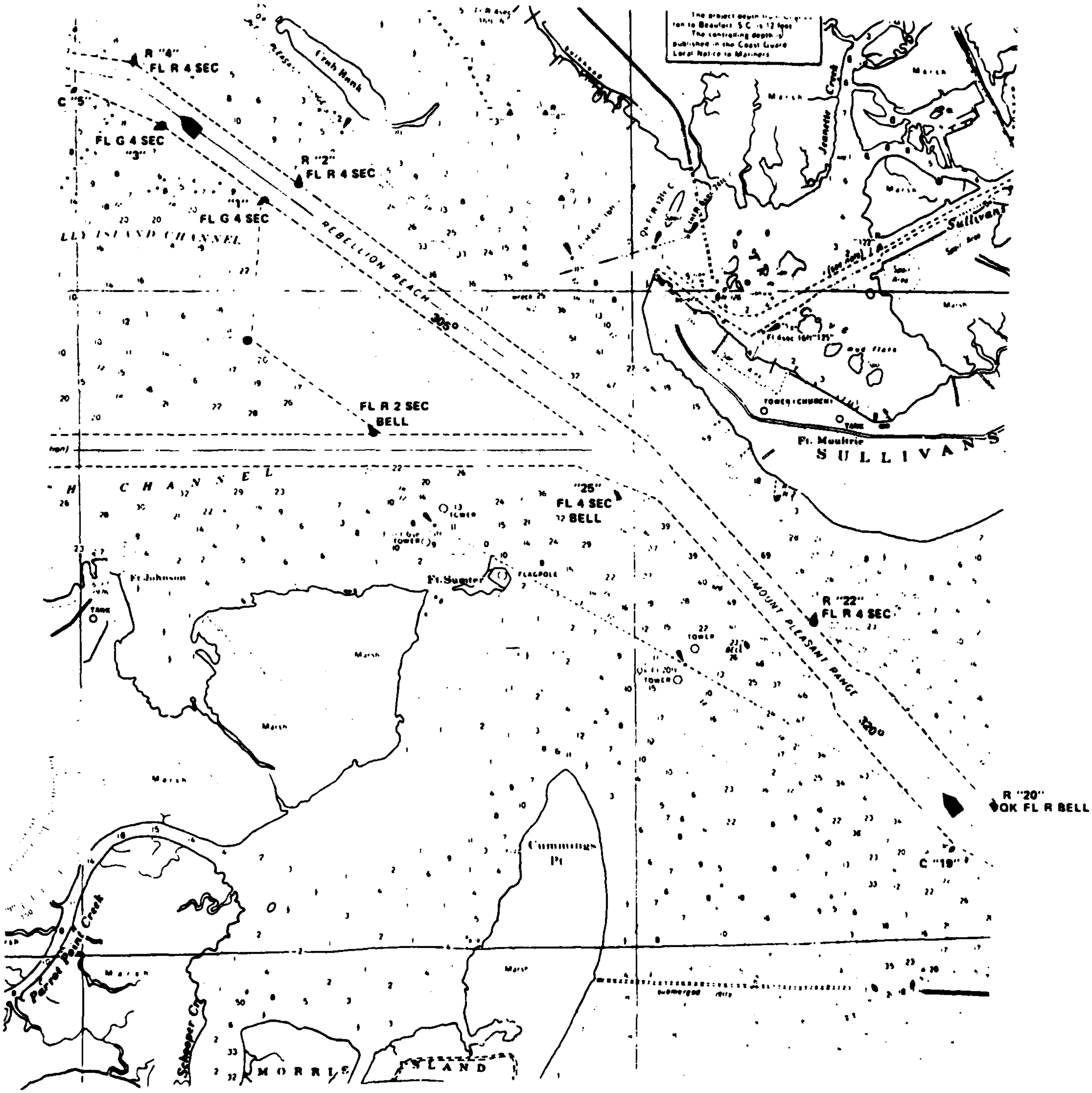

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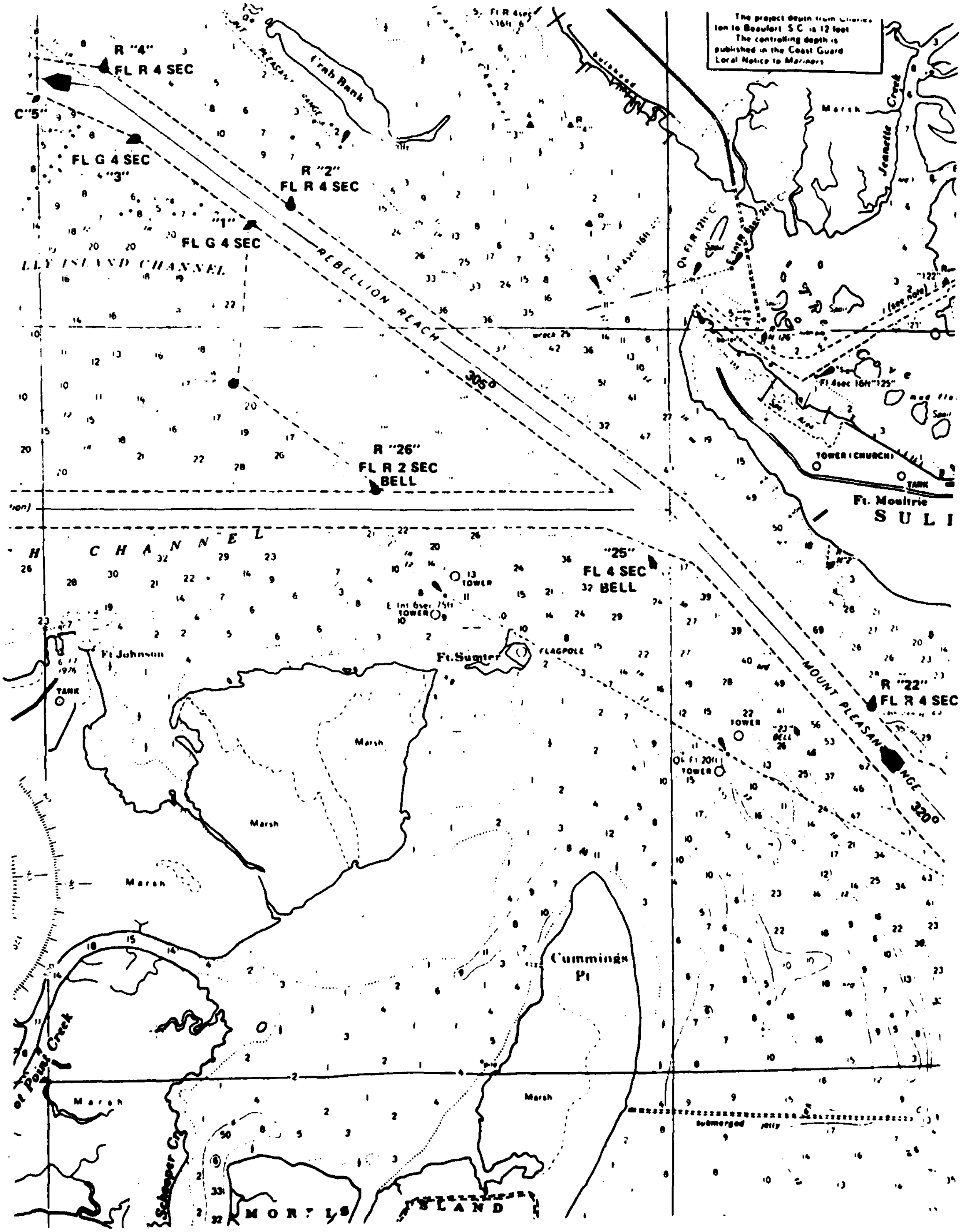

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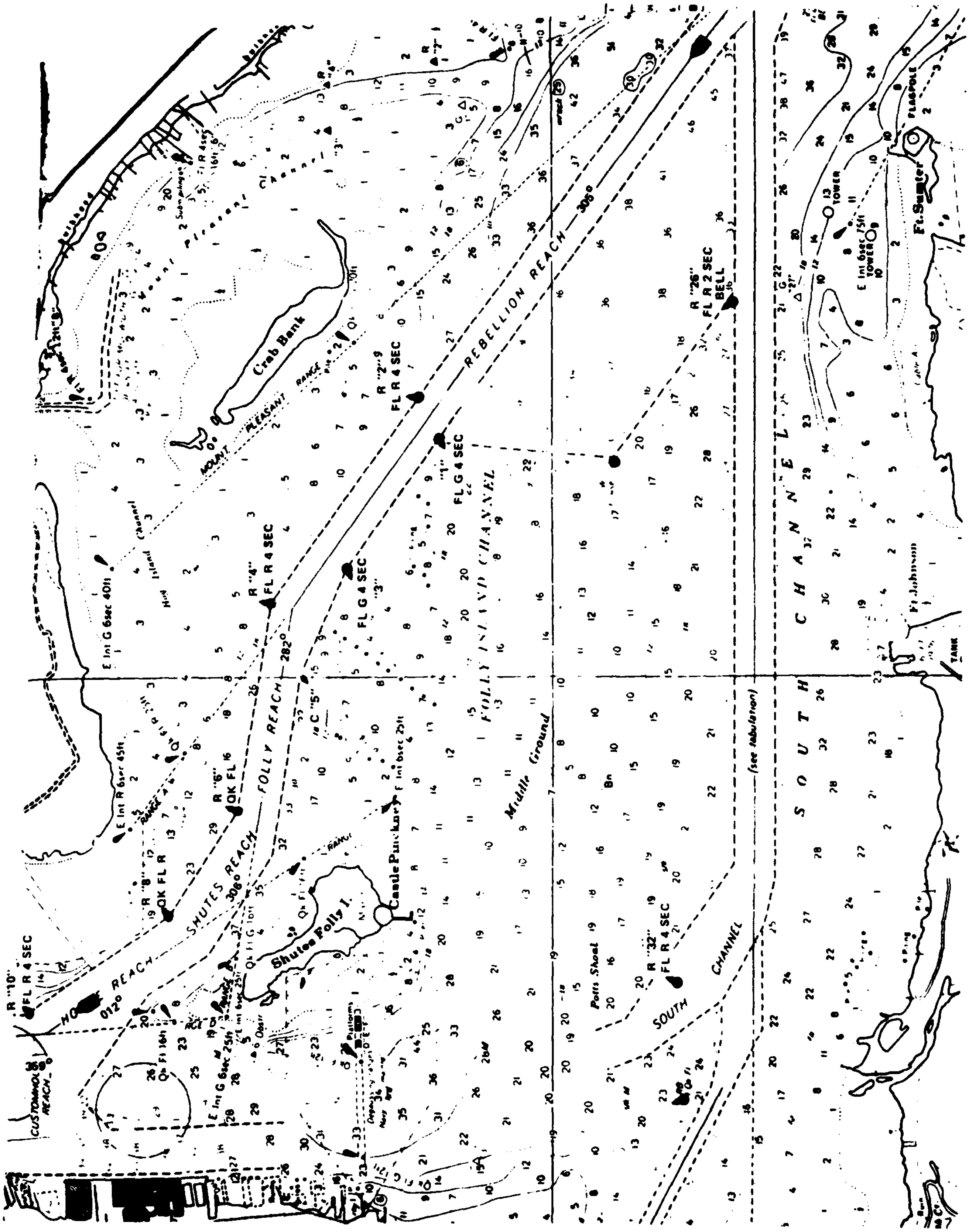
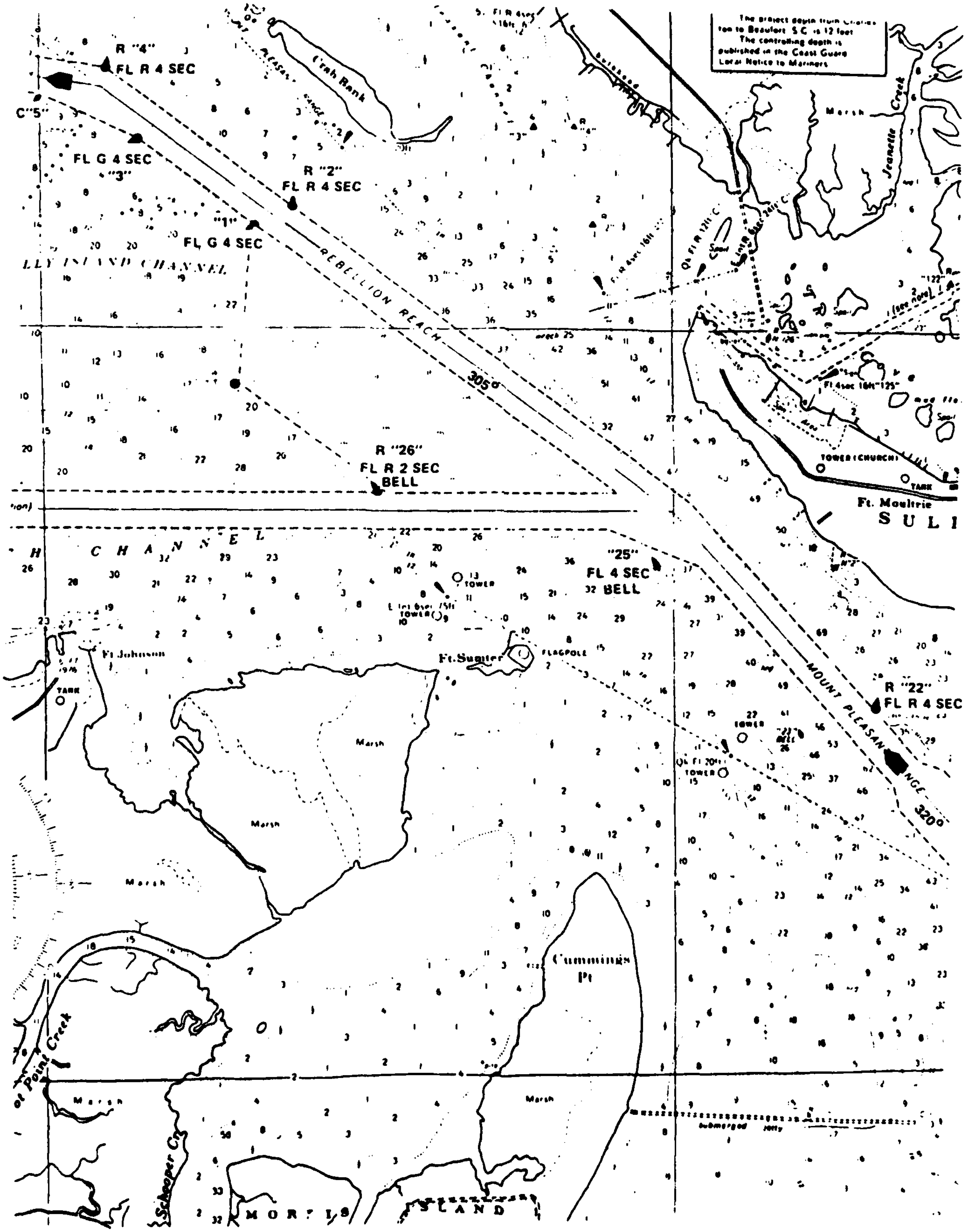
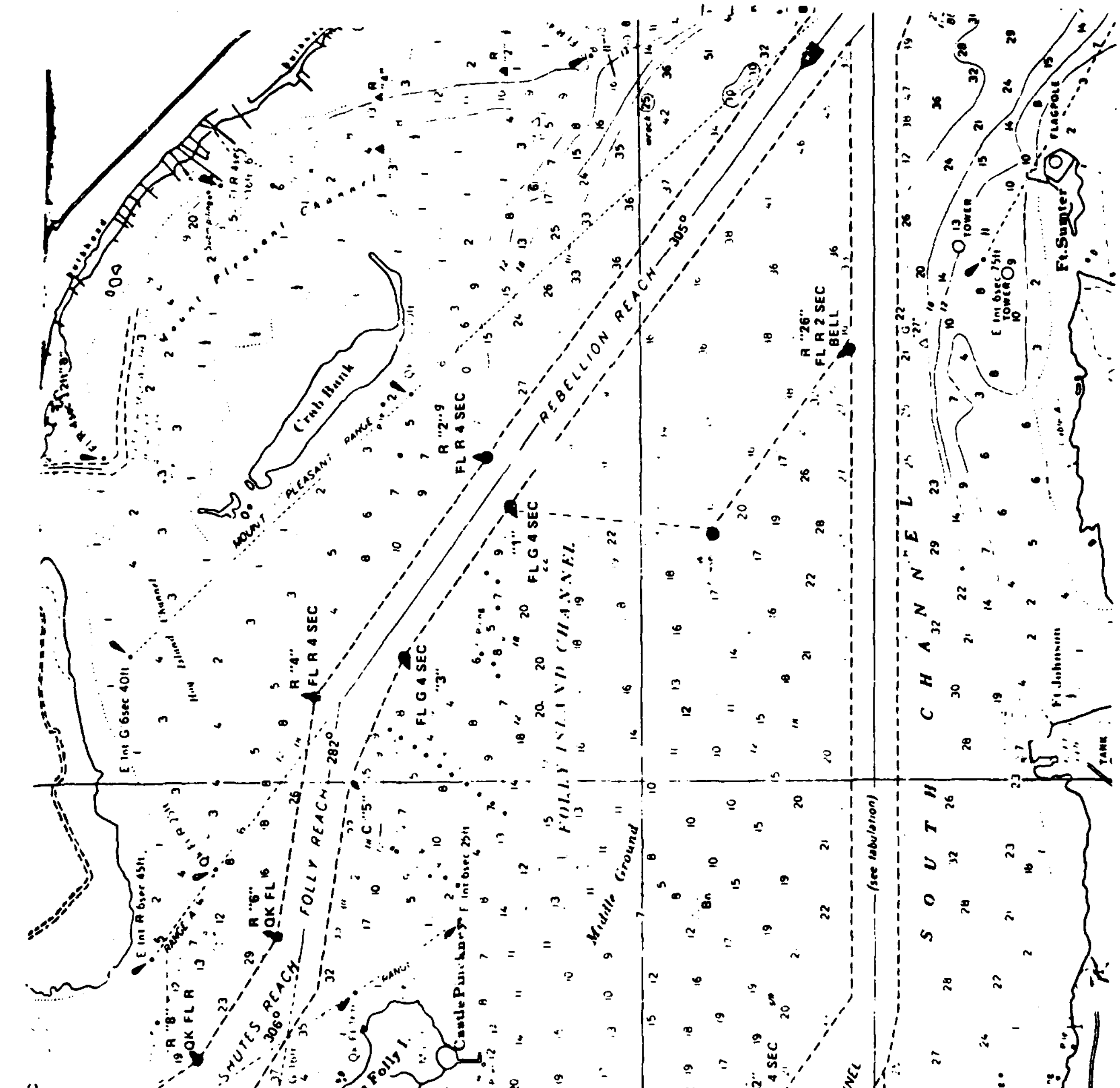


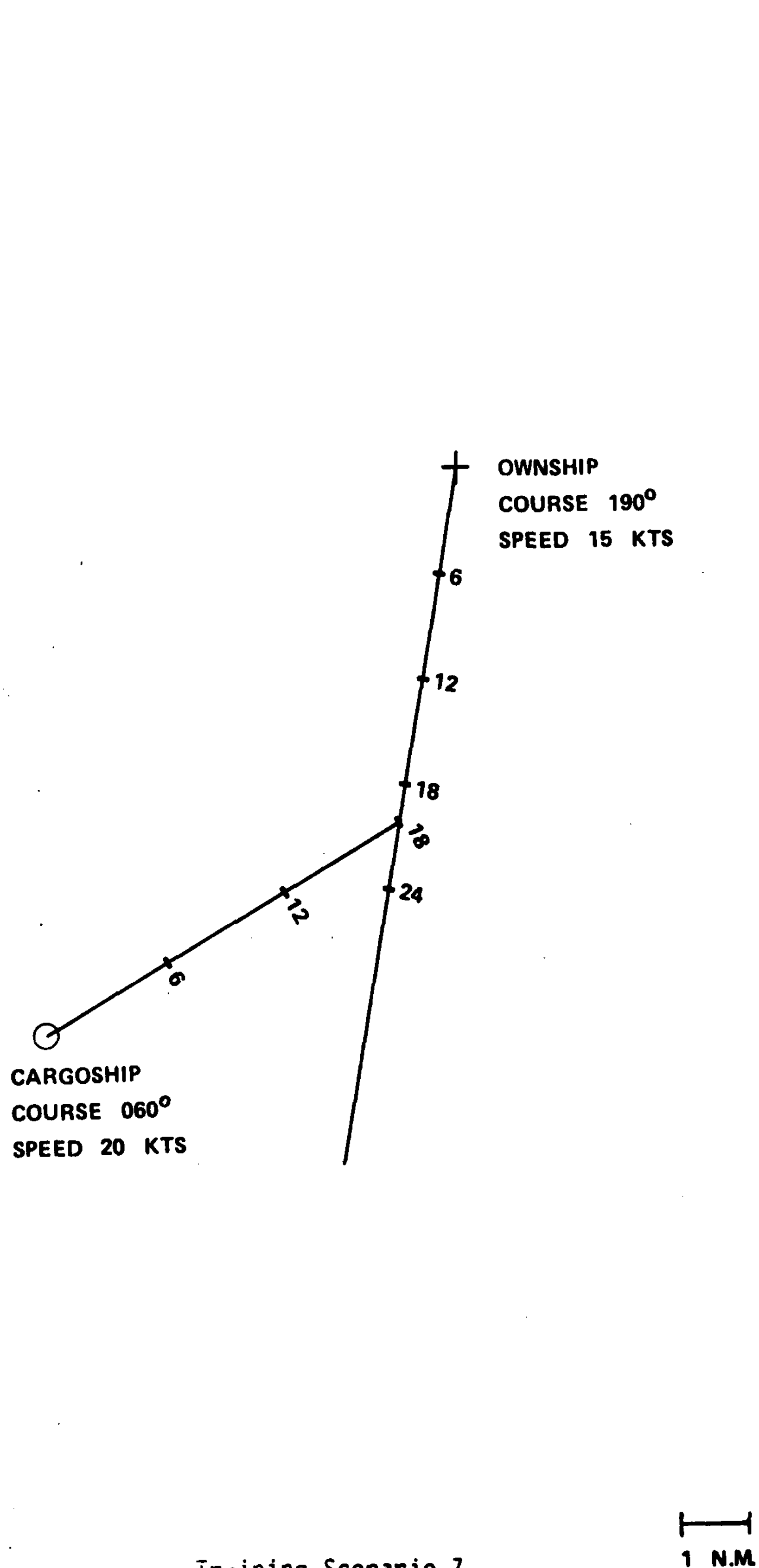
CURRENT CHART 6



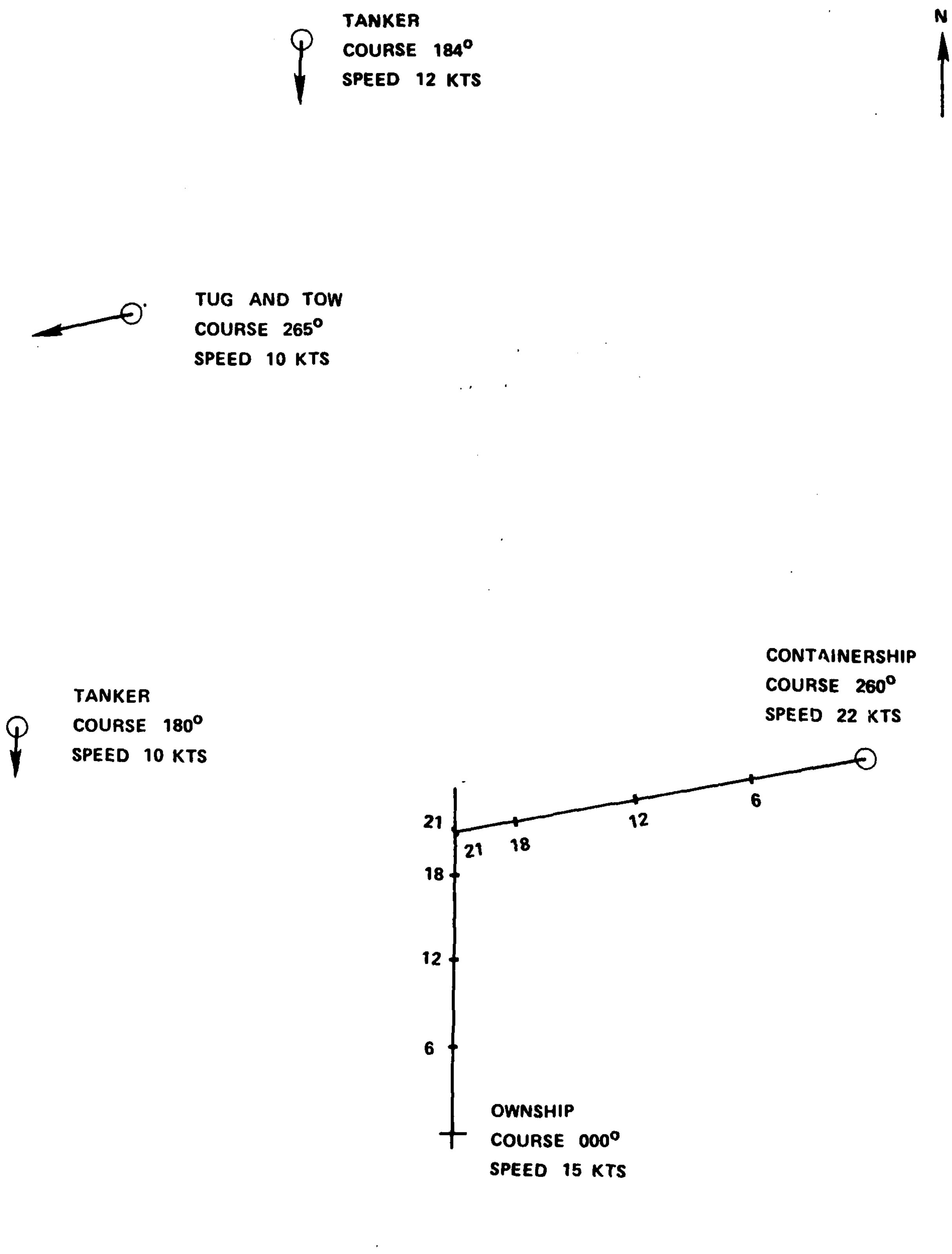
Training Scenario 6A (Night)



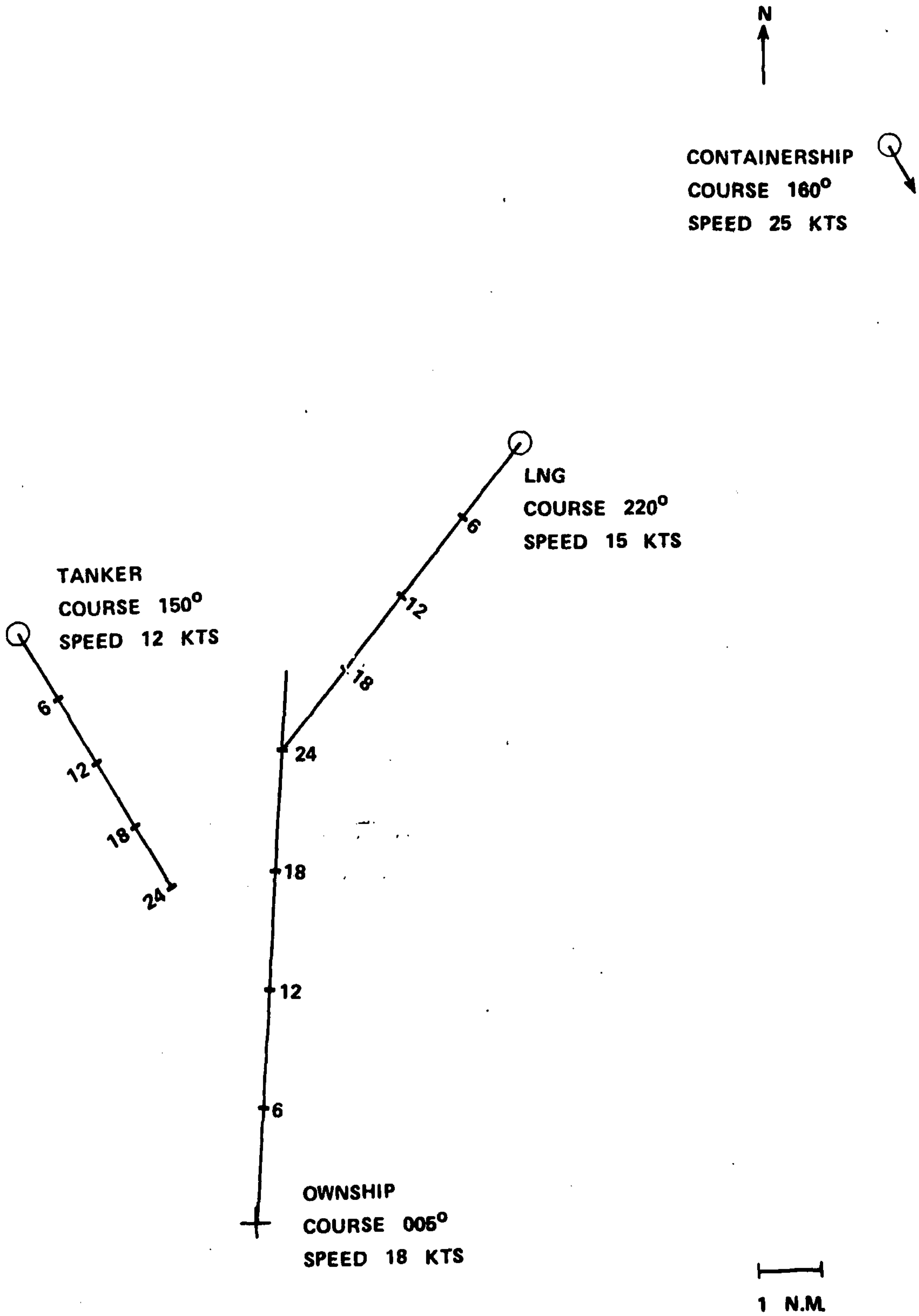
Training Scenario 6B (Day)



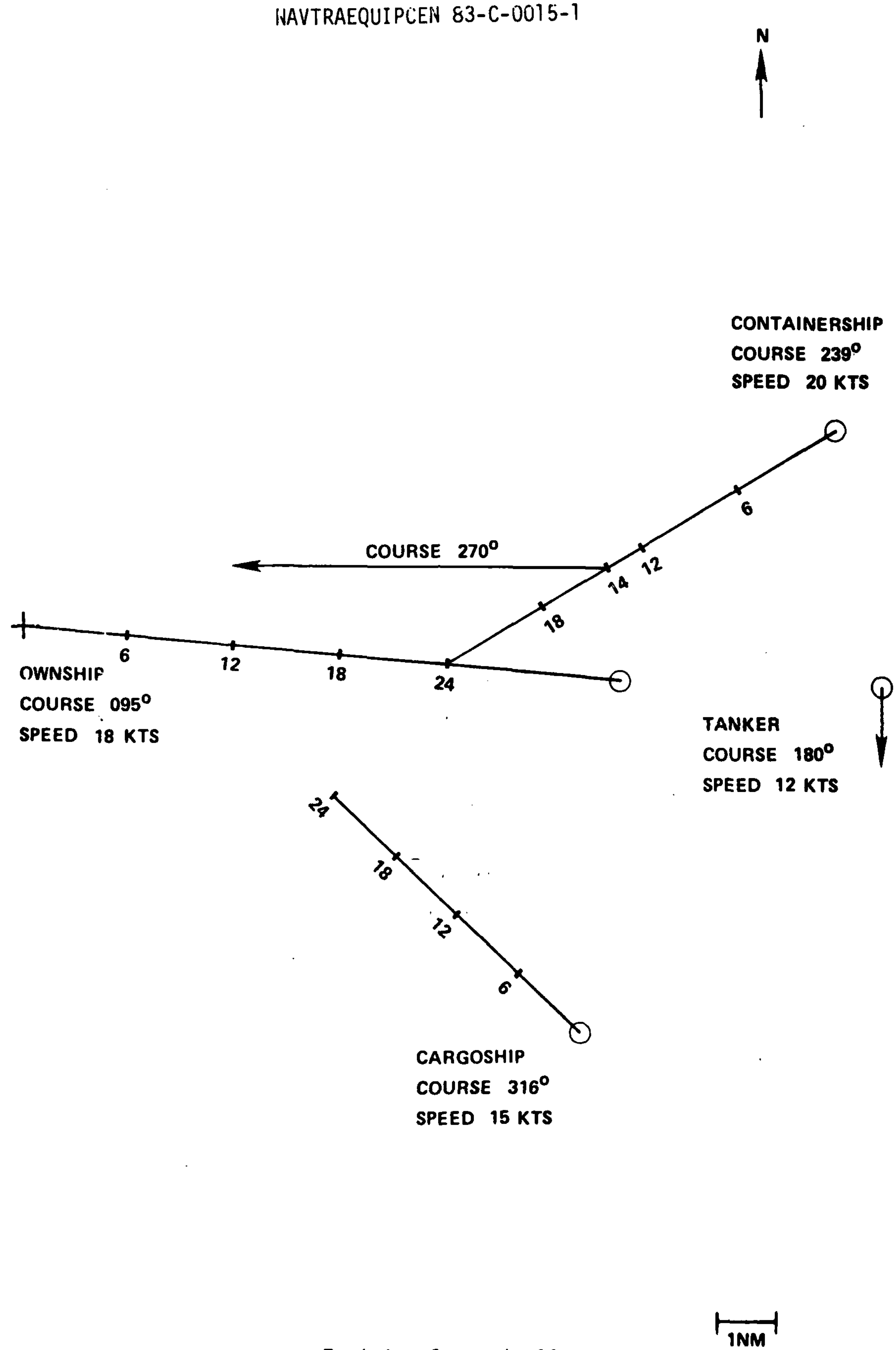
Training Scenario 7



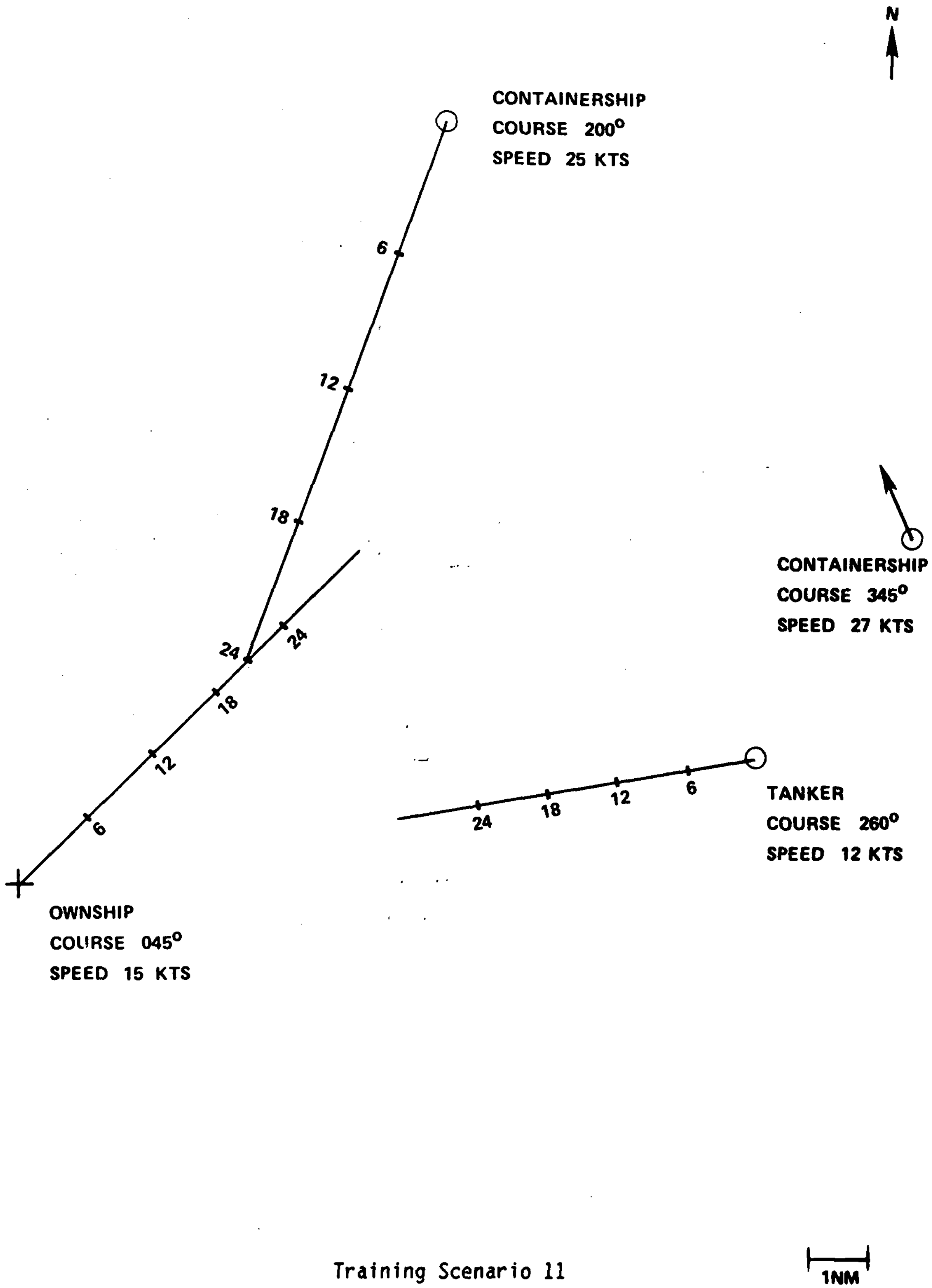
Training Scenario 8



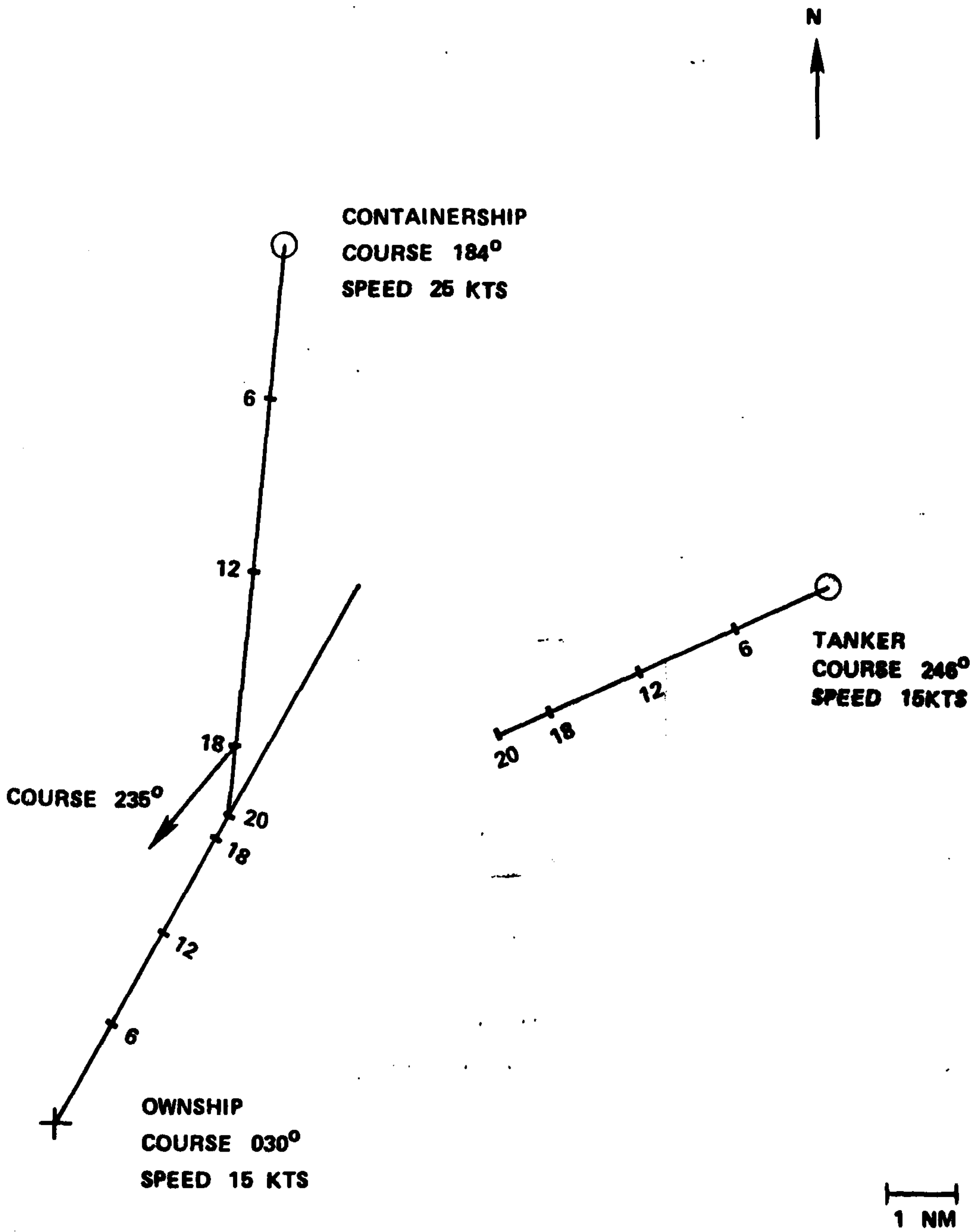
Training Scenario 9



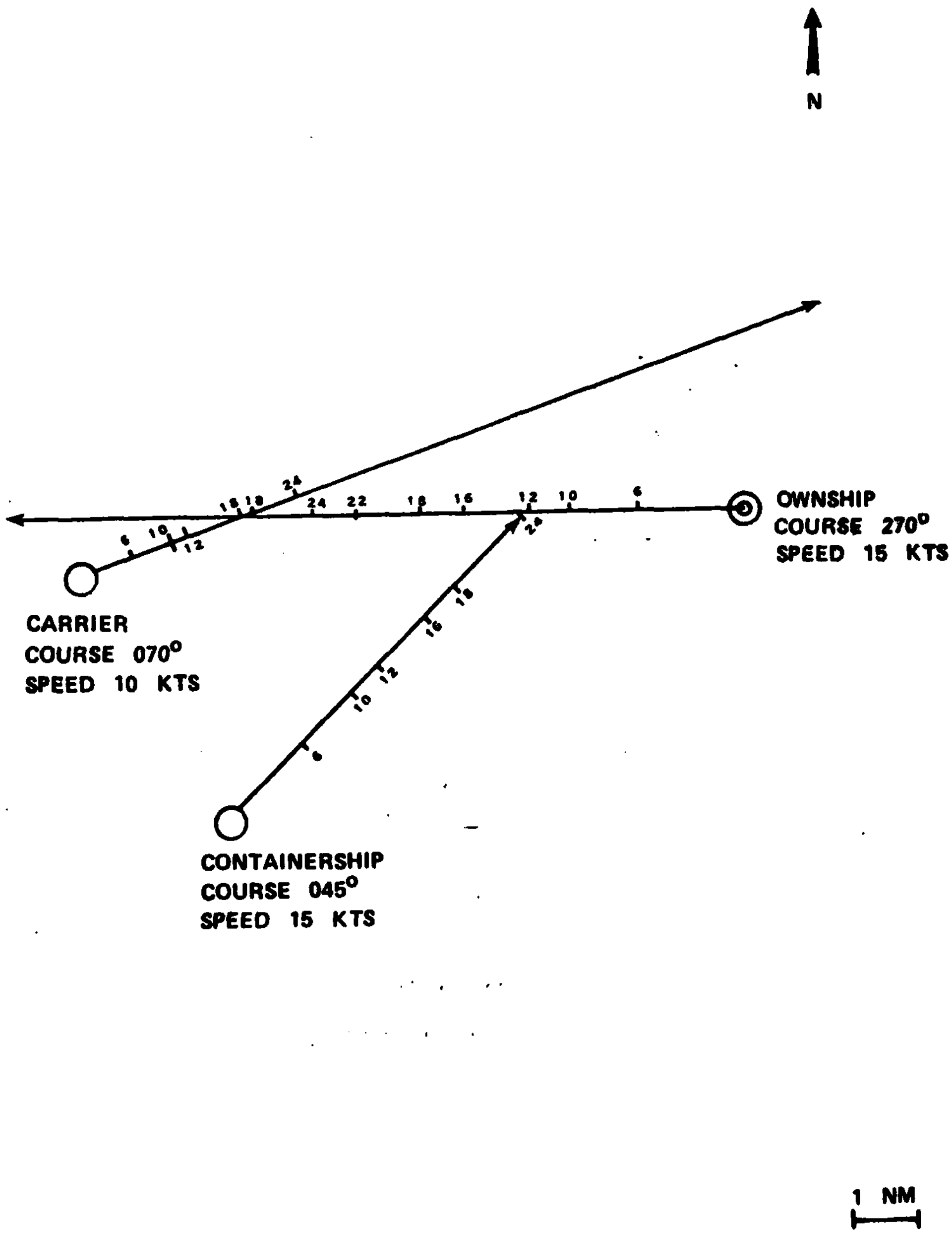
Training Scenario 10



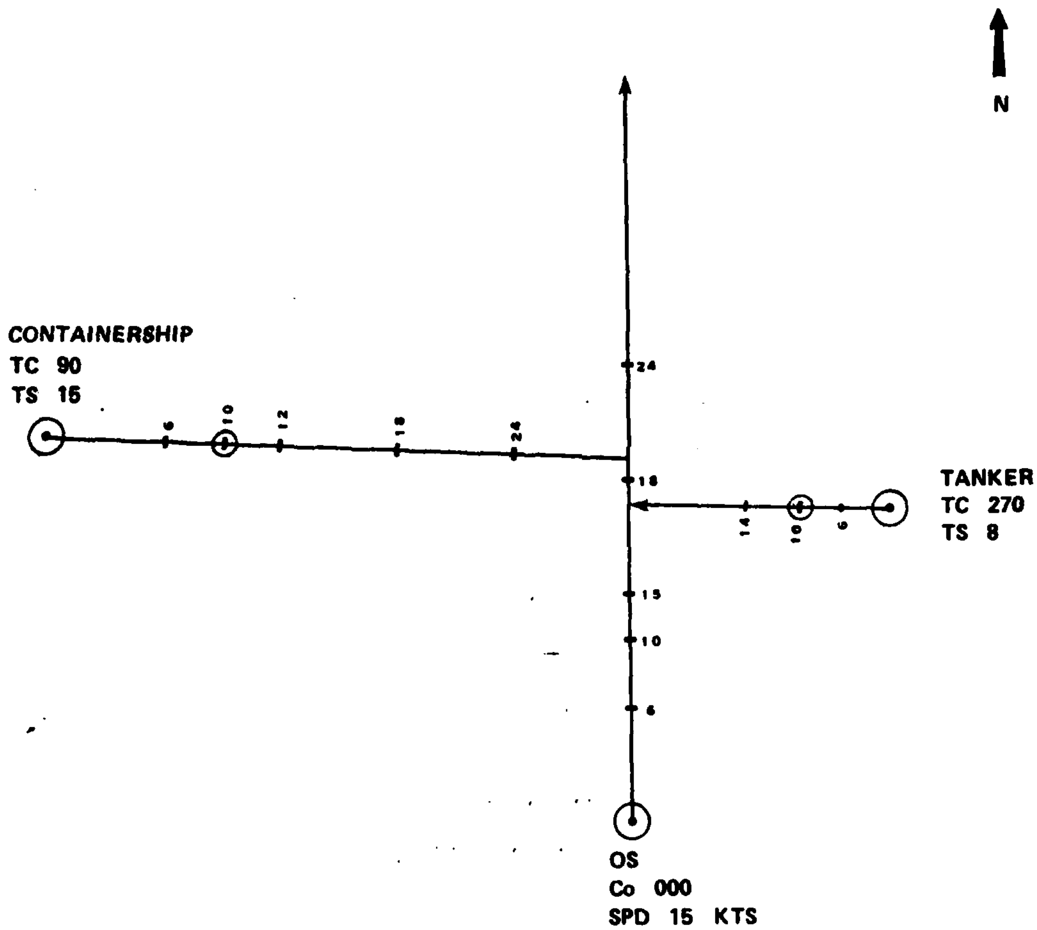
Training Scenario 11



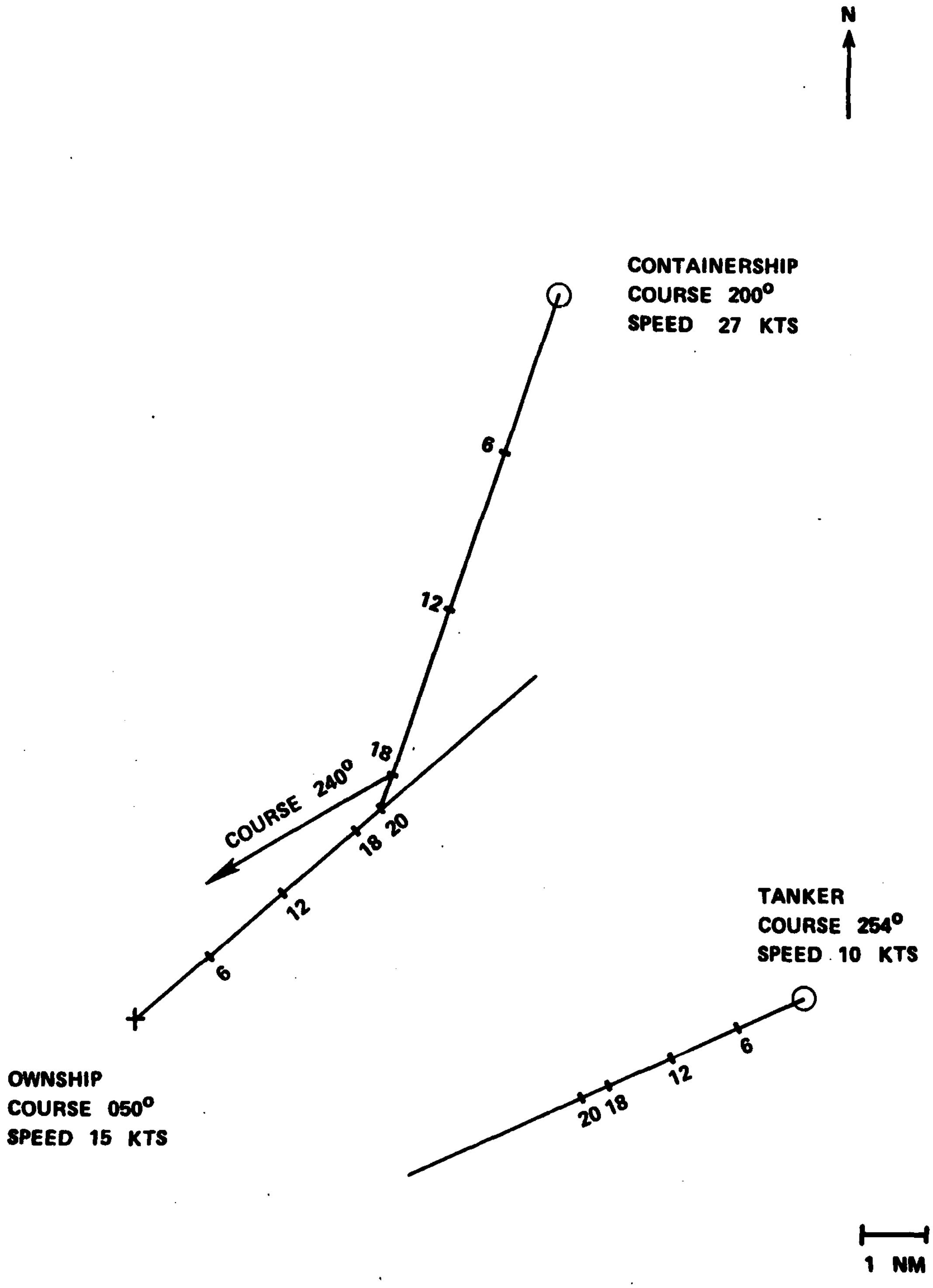
Training Scenario 12



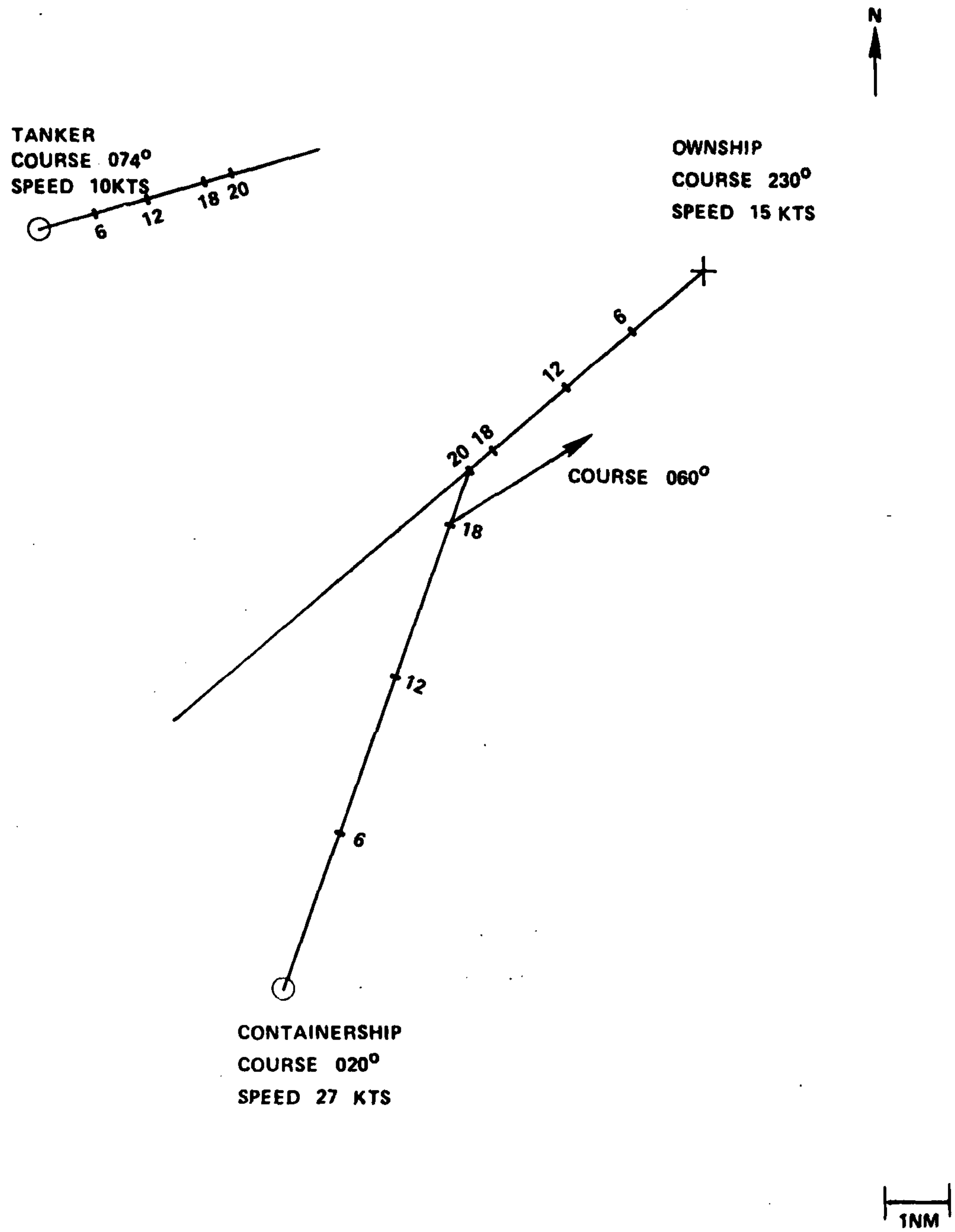
Training Scenario 13



Training Scenario 14



Collision Avoidance Pre-Posttest (PPT 3)



Pre-Posttest Scenario 4 (PPT 4)

APPENDIX B

SHIPHANDLING THEORY TEST

PARTT-SHIP STUDENT DATA SHEET

Name ____ Rank ____________
Last First MI Yes. in Service ______

Source of Commission
(a) USNA
(b) OCS
(c) NROTC
(d) Direct
(e) Other ________________
Specify

SWOS PQS Completed
(a) OOD(P)
(b) DIVOF
(c) ENG
(d) CICWO
(e) OOD(U)
(f) WARFARE

Undergraduate degree, major, school and year awarded

Ship's Served In - Hull # or Type, i.e., DD, DDG, CG, FF, LKA, etc.

Past Shiphandling Experience and Qualifications, e.g., JOOD-3, mos., JOOW-1 mo. etc.

Previous Sea Duty (Number of months)

Have you have any other previous boating/shiphandling training or schools? If so, state type and duration.

Weeks of SWOS (B) Completed? (if applicable)

____________ weeks

Trainee Entry Level Assessment Test

1. Which of the below listed classes of vessels is required to keep out of the way of the others listed?

   a. A sailing vessel underway
   b. A vessel engaged in fishing
   c. A power vessel underway
   d. A vessel restricted in her ability to maneuver

2. At what minimum range must side lights be visible for a vessel of 50 meters or more in length?

   a. 2 miles
   b. 3 miles
   c. 1 mile
   d. None of the above

3. What lights must be exhibited by a vessel engaged in fishing, other than trawling, under the international rules of the road?

   a. Two all around lights in a vertical line, the upper red and the lower white, side lights and a stern light.

   b. Two all around lights in a vertical line, the upper green and the lower white, side lights and a stern light.

   c. Two all around lights in a vertical line, the upper white and the lower red, side lights and a stern light.

   d. Two all around lights in a vertical line, the upper white and the lower green, side lights and a stern light.

4. What class of vessels, when underway, is required to exhibit three all around lights in a vertical line, the highest and lowest red with the middle light white, a masthead light or lights, side lights and a stern light, under the international rules of the road?

   a. A vessel constrained by draft

   b. A vessel restricted in her ability to maneuver

   c. A vessel engaged in a towing operation which severely restricts her ability to deviate from course

   d. A vessel engaged in mine clearing operations

5. What day shapes must be exhibited under the international rules of the road by a vessel not under command?

   a. Two balls or similar shape in a vertical line

   b. A diamond shape

   c. Two diamond shapes in a vertical line

   d. A shape consisting of two cones with apexes together in a vertical line one above the other

6. What sound signal shall a ship altering her course to port sound when in sight of another vessel, under the international rules of the road?

   a. One prolonged blast
   b. Two short blasts
   c. Two prolonged blasts
   d. One short blast

7. What equipment for sound signals must vessels of 12 meters or more in length have, under the international rules of the road?

   a. A whistle and gong
   b. A whistle, gong and bell
   c. A whistle and bell
   d. A whistle only

8. How many degrees of unbroken horizontal ARC must a masthead light show?

   a. 112.5 degrees
   b. 67.5 degrees
   c. 135 degrees
   d. 225 degrees

9. What action must a stand-on vessel take under the international rules of the road?

   a. Maintain her course and speed

   b. Maneuver to avoid collision should the other vessel not act in compliance with the international rules

   c. Not alter course to port or a vessel on her own port side in a crossing situation

   d. All of the above

10. Under the international rules, for a contract bearing 320^{o} relative if two masthead lights are visible with good horizontal separation and a green running light the situation is:

a. A meeting situation
b. An overtaking situation
c. A crossing situation
d. None of the above

11. Which vessel must give way given the light configuration of question #10?

a. Your vessel
b. The other vessel
c. Both vessels
d. Neither vessel

12. In what direction must the mudder be positioned to turn a single screw, single rudder ship to starboard when moving ahead?

a. Left
b. Right
c. Midships with zero pitch on the screw
d. Midships with forward pitch on the screw

13. When backing down with the rudder to the right, which direction will the bow move?

14. Which of the following describes the term "advance"?

a. The distance gained by a vessel to the left or right of original track from the time the helm is put hard over until the ship has turned to its new heading.

b. The rate of change in heading over time from the time the helm is put hard over until the ship has gained its new heading.

c. The increase in rate of motion of the ship due to changes in propulsion power.

d. The distance the ship was moved in a direction parallel to the original course measured from the pint where the helm was put over until the new heading is gained.

15. Which of the below definitions describe the term transfer?

    a. The distance gained by a vessel to the left or right of original track from the time the helm is put hard over until the ship has turned to its new heading.

    b. The rate of change in heading over time from the time the helm is put hard over until the ship has gained its new heading.

    c. The increase in rate of motion of the ship due to changes in propulsion power.

    d. The distance the ship was moved in a direction parallel to the original course measured from the point where the helm was put over until the new heading is gained.

16. What action should the OOD take when visibility is reduced from normal visual conditions to below 2nm?

    a. Call to captain
    b. Set the low visibility detail in CIC and the bridge
    c. Adjust radar PPI range scale down to short scale
    d. Sound fog signals
    e. All of the above

17. You are maneuvering at 8 knots in a narrow channel with a 35 degree turn to the left ahead. What effect, if any, will a following current of 1 knot have on the ship turn?

    a. None
    b. Increase ship's advance
    c. Increase ship's transfer
    d. Both B and C

18. Of what significance to ownship is a visual contact reported to have a target angle of 010 degrees?

    a. None
    b. Minimum as the contact is moving away from ownship
    c. Great as the contact in moving toward ownship
    d. Extraordinary as hiw bow is embedded in your bow

19. What does the acronym CBDR mean?

    a. Can't bear dinner rations
    b. Crossing bogeys, detected radar
    c. Constant bearing decreasing range
    d. Cans black department right

20. At 0800, ownship is on cse 000/20. For a contact bearing 001, 20nm on cse 180/10. What is the time of CPA?

    a. 0820
    b. 0840
    c. 0900
    d. Never

APPENDIX C

DATA COLLECTION FORMS

INSTRUCTOR SCENARIO CHECKLIST FOR RESTRICTED WATERS SHIPHANDLING

SCENARIO NO. ____________________ DATE ____________________

INITIAL CSE ____________________ START TIME ____________________

INITIAL SPD ____________________ STOP TIME ____________________

I. TRACKKEEPING

	POOR	FAIR	GOOD	EXCELLENT
MANEUVER TO CENTERLINE				
LEG 1				
LEG 2				
LEG 3				
LEG 4				
LEG 5				
LEG 6				

COMMENTS: ____________________

____

____

II. TURNMAKING

TURN 1	POOR	FAIR	GOOD	EXCELLENT
Advance & Transfer Predicted				
Wind/Current Compensation Applied				
Correct Turnpoint Selected				
Proper Conning Orders Used				
Visual Cues Utilized				

COMMENTS: ____________________

____

____

TURN 2	POOR	GOOD	FAIR	EXCELLENT
Advance & Transfer Predicted				
Wind/Current Compensation Applied				
Correct Turnpoint Selected				
Proper Conning Orders Used				
Visual Cues Utilized				

COMMENTS:

TURN 3	POOR	FAIR	GOOD	EXCELLENT
Advance & Transfer Predicted				
Wind/Current Compensation Applied				
Correct Turnpoint Selected				
Proper Conning Orders Used				
Visual Cues Utilized				

COMMENTS:

TURN 4	POOR	FAIR	GOOD	EXCELLENT
Advance & Transfer Predicted				
Wind/Current Compensation Applied				
Correct Turnpoint Selected				
Proper Conning Orders Used				
Visual Cues Utilized				

COMMENTS:

TURN 5	POOR	FAIR	GOOD	EXCELLENT
Advance & Transfer Predicted				
Wind/Current Compensation Applied				
Correct Turnpoint Selected				
Proper Conning Orders Used				
Visual Cues Utilized				

COMMENTS: ____

____

____

III. SITUATION EVALUATION

	POOR	FAIR	GOOD	EXCELLENT
Charts Use				
Aids to Navigation Use				
PPI Use				
CIC Use				
Conning Officer Ability				

COMMENTS: ____

____

____

IV. COMMUNICATIONS

Intra-Ship Type Selected ______________________

Comms Use	POOR	FAIR	GOOD	EXCELLENT

V. GENERAL BRIDGE TEAM PROCEDURES

Aux Panel OP Performance	POOR	FAIR	GOOD	EXCELLENT

COMMENTS: ____

____

____

Helmsman Performance	POOR	FAIR	GOOD	EXCELLENT

COMMENTS: ____

____

____

Conning Officer Performance	POOR	FAIR	GOOD	EXCELLENT

COMMENTS: ____

____

____

Bridge Team Coordination	POOR	FAIR	GOOD	EXCELLENT
On Bridge				
With CIC				

COMMENTS: ____

____

____

VI. OVERALL TRANSIT EVALUATION

	POOR	FAIR	GOOD	EXCELLENT
Trackkeeping				
Turnmaking				
Channel Egress, If Any (Time - Place)				

COMMENTS: ____

____

____

VII. INSTRUCTORS EVALUATION OF STUDENTS

Beginning Abilities	Poor	Fair	Good	Excellent
Interaction	Poor	Fair	Good	Excellent

COMMENTS: ______________________________

____

____

INSTRUCTOR SCENARIO CHECKLIST
OPEN OCEAN MANEUVERING AND COLLISION AVOIDANCE

SCENARIO ____________________ DATE ____________________

OS COURSE ____________________ START TIME ____________________

OS SPEED ____________________ STOP TIME ____________________

I. ESTABLISHMENT OF RISK OF COLLISION

PPI:

Contact	Actual CPA	Computed CPA	Time Est.
A			
B			
C			

COMMENTS: ____

____

____

Visual Bearings:

Yes/No

Number:

COMMENTS: ____

____

____

II. NOTIFICATION OF COMMANDING OFFICER

Time Notification: ____________________

Timeliness   Early   Proper   Late

COMMENTS: ____

____

____

Accuracy Poor Fair Good Excellent

COMMENTS: ____

____

____

Completeness Poor Fair Good Excellent

COMMENTS: ____

____

____

ROR Interpretation Poor Fair Good Excellent

COMMENTS: ____

____

____

III. PROPER MANEUVER

Initial Maneuver

	Recommended	Actual
Time		
Range		
Direction		
Magnitude		
Whistle Signal		

COMMENTS: ____

____

____

Subsequent Maneuvers

Standard Commands	Poor	Fair	Good	Excellent

COMMENTS: ______________________________

____

____

IV. COMMUNICATIONS

Inter-Ship	Poor	Fair	Good	Excellent
Type Selected				
Intra-Ship	Poor	Fair	Good	Excellent
Type Selected				

COMMENTS: ______________________________

____

____

V. GENERAL BRIDGE TEAM PROCEDURES

Conning Ability	Poor	Fair	Good	Excellent

COMMENTS: ______________________________

____

____

Aux Panel Performance   Poor   Fair   Good   Excellent

COMMENTS: ______________________________

____

____

Helmsman Performance   Poor   Fair   Good   Excellent

COMMENTS: ______________________________

____

____

Coordination   Poor   Fair   Good   Excellent

COMMENTS: ______________________________

____

____

VI. RANGE AT SCENARIO TERMINATION/TRAINEE'S PROJECTED CPA

	Range	CPA
Contact A		
Contact B		
Contact C		
Contact D		

COMMENTS: ______________________________

____

____

VII. INSTRUCTORS EVALUUATION OF STUDENTS

Beginning Abilities   Poor   Fair   Good   Excellent

Interaction   Poor   Fair   Good   Excellent

COMMENTS: ______________________________

____

____

APPENDIX D

COMMANDING OFFICER STANDING NIGHT ORDERS

APPENDIX D

COMMANDING OFFICER STANDING ORDERS FOR TRAINING EXERCISES

1. RELIEVING (ASSUMING) THE WATCH

   a. Read the standing orders and night orders book.

   b. Know the true and gyro courses being steered and the course being made good, engines in use, base speed, steering pump(s) in use, and speed made good.

   c. Check the radar scope for targets in sight. Check the CPA by plotting the bridge radar or on a maneuvering board.

   d. Check the wind direction and the direction of any prevailing current.

2. STANDING THE WATCH UNDERWAY

   a. Maintain a DR for every 10 minutes.

   b. Maintain an alert lookout and an alert radar watch, but do not place full reliance on either.

   c. Correlate all radar contacts with visual contacts. Use visual bearings to determine contact bearing drift. Keep a plot on the radar.

   d. Maintain a well-darkened bridge and a quiet bridge at all times.

   e. <u>CALL ME AND REPORT:</u>

      (1) When in doubt as to the safety of the ship.

      (2) Changes in status or casualties to equipment.

      (3) When a course change (to base course) of greater than 5 degrees or a speed change (to base speed) of more than 2 knots is required to maintain/regain track.

      (4) Any change to the base speed/course of the formation or change in the ships assigned station.

      (5) When any target (visual or radar) has a CPA of 5,000 yards or less. Call me BEFORE these targets are inside of 10,000 yards or as soon as acquired if within 10,000 yards. When you call me for targets outside 10,000 yards be able to give me:

         (a) Relative bearing and present range to contact.

         (b) Relative bearing, range, and approximately time of CPA.

         (c) Whether or not you have the contact visually.

(d) Contact closing range and bearing drift.

(e) Contact aspect and pertinent rules of the road information.

(f) Your recommended action.

3. Thorough knowledge of the rules of the road and practical bridge operations will greatly assist you in taking the proper action at the proper time. They do not, however, relieve you of your responsibility for using initiative and common sense. The two foremost precepts for you to remember are FORESIGHT and VIGILANCE. You must be prepared to meet various situations which can occur at sea. I expect to be consulted when it is necessary to deviate from the planned action; however, <u>should circumstances warrant it, do not hesitate to ACT NOW AND TELL ME LATER</u>.

SAL T. DOG
Commanding Officer

USS PARTTSHIP (FFG-X1)
P.O. Box 178, North Stonington
Professional Center
North Stonington, Ct. 06359

Night Orders for: Collision Avoidance Exercises

Ships Position at 2000 hrs: Latitude 32° 15'N, Longitude 79°, 25'W in Charleston OPAREA W-4

PIM: Point Alpha in W-2, Latitude 32°, 25'N, Longitude 79°, 25'W

SOA: 12 knots

CSE: As required Speed as required

Engineering Plant: 1 and 2 Gas Turbine Engine on the line in automatic direct control from bridge Ship Control Console.

1 and 3 Turbo Generators on line, #2 Turbo Generator tagged out for Preventive Maintenance.
Maximum Revolutions per minute 180 RPM
Maximum speed available 29 KTS
Plant casualties: None

Night Intentions: Night steam is OPAREAS W-2, W-3, W-4 of the Charleston operating areas, on various courses and speeds to arrive at PIM, NLT 0700 preparatory, to entering port. Contact Charleston Operating Area Control (COAC) on arrival at PIM and report ETA at Sea buoy R "2" C. Set the navigation detail 1/2 hour prior to arrival at PIM. The special sea and anchor detail will be set on arrival at R "2" C.

CASREP EQUIPMENT:
#3/AN/URC-20 transceiver
AN-SPS 49 ADT UYK-20
DDC AN/OJ-194 #3 LDT
MT 51, MK 75, 76 MM GUN

Scheduled Evolutions:

1) Bridge team conduct Z-13-CC (non-maneuvering) with CIC on all watches IAW LOE event 2712 and FFG-X1 OPS NOTE 83-47.

2) Engineering plant to conduct ECC's on 00-04 watch on a not to interfere W/ PIM BASIS. All OOD's ensure proper bridge procedures and responses carried out.

Captains Notes:

1) All watchstanders cooperate fully and bridge respond for ECC's - This is the last drill set prior to U/W for OPPE so let's make the most of it. Play your part aggressively.

2) As we steam OPAREAS W4-W2 you are reminded this is a high shipping movement area. Re-read the standing orders with particular emphasis on contact reporting and CPA requirements. Adhere to these requirements scrupulously in calling me and call me when in doubt, in any case!

Sal T. Dog
CDR USN
Commanding Officer

APPENDIX E

PARTT-SHIP RATER SURVEY

PARTTSHIP RATER BACKGROUND

Name (Optional)________________________ Rank____________
Last First MI Yrs in Service________

Source of Commission
(a) USNA
(b) OCS
(c) NROTC
(d) Direct
(e) Other______________
Specify

SWOS PQS Completed (if applicable)
(a) OOD(P)
(b) DIVOF
(c) ENG
(d) CICWO
(e) OOD(U)
(f) WARFARE

Undergraduate degree, major, school and year awarded

Ships Served In - Hull # or Type, i.e., DD, DDG, CG, FF, LKA, etc.

Past Shiphandling Experience and Qualifications, e.g., OOD (# yrs), Conning Officer (# yrs), etc.

Previous Sea Duty (number of years/months)

Have you had any other previous boating/shiphandling training or schools? If so, state type and duration.

PARTT-SHIP OPINION

This survey has been constructed to give the designers of the PARTT-SHIP model a better understanding of user's opinion of its potential for training. The PARTT-SHIP project exists for design and development of a shiphandling principles and concepts part-task trainer for the Navy. Its mission is to train junior and intermediate level officers in these shiphandling areas:

- Getting underway from alongside a pier
- Making a landing alongside a pier
- Maneuvering in restricted waters
- Entering port
- Collision avoidance
- Formation steaming
- Underway replenishment
- Mooring to a buoy
- Making a Mediterranean moor
- Weighing anchor

At present, two of the above areas, maneuvering in restricted waters and collision avoidance, have been developed in detail. Other areas have been developed for demonstration purposes.

Please answer the following questions based on your experiences with the PARTT-SHIP device. Each statement is to be rated on a scale of 1 to 5, except multiple choice questions. A score of 5 represents complete agreement with the statement; a score of 3 represents moderate agreement; a score of 1 means disagreement. Please write out comments when necessary to clarify an answer.

A. CONTROL PANELS

1. Controls are complete, i.e., all actuators and indicators necessary for conning the ship exist in some form on the panels.

Agree				Disagree
5	4	3	2	1

COMMENTS: ______________________________

____

____

2. Controls were easy to operate.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

3. Indicators were easy to read and well placed.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

4. The physical positioning was good for conning officer, helmsman, and auxiliary operator.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

B. VISUAL SCENE

5. The horizontal field of view (port to starboard) was adequate for training purposes.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

6. The clarity (resolution) of objects in the computer generated scene was adequate for shiphandling operators at the stated visibility and range.

Agree 5 4 3 2 1 Disagree

COMMENTS: ______________________________

7. The detail of scene (i.e., the number of objects and their physical characteristics) was adequate.

Agree 5 4 3 2 1 Disagree

COMMENTS: ______________________________

C. SHIPHANDLING CHARACTERISTICS (HYDRODYNAMICS)

8. The effects of current and wind were realistic.

Agree 5 4 3 2 1 Disagree

COMMENTS: ______________________________

9. Engine and rudder responses (i.e., delays in rudder response and answering bells) were characteristic of those of an FFG-7 class ship.

Agree 5 4 3 2 1 Disagree

COMMENTS: ______________________________

10. The ship stopped, turned, and accelerated like an FFG-7 class ship.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

11. The tugs and anchors were easy to use and responded as a real anchor or tug would respond.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

D. DISPLAYS

12. Predictor information on the situation display is useful for shiphandling training.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

13. The history plots were valuable feedback in assessing past actions.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

14. The PPI "situation" display of ownship at the center of a "birds eye" view, relative to a channel or other ships, is a good training device.

Agree				Disagree
5	4	3	2	1

COMMENTS:______________________________

15. Feedback displays on the center CRT of the visual scene were useful feedback for understanding the conning officer's performance in a scenario.

Agree				Disagree
5	4	3	2	1

COMMENTS:______________________________

E. FIDELITY

16. The visual displays were reasonable representations of the real world for training purposes.

Agree				Disagree
5	4	3	2	1

COMMENTS:______________________________

17. The computer generated images provided adequate environmental information so that the differences between "real world" visual scene content and the computer drawn scenes were not important.

Agree				Disagree
5	4	3	2	1

COMMENTS:______________________________

18. Buoys, other ships, and cultural objects were well represented and easily identified.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

F. UTILITY

19. The device, in its current design, will be a good means for training shiphandling principles and concepts to Navy officers who have not already become accomplished shiphandlers.

Agree				Disagree
5	4	3	2	1

COMMENTS:____

20. Which of the following do you feel is the most important and useful subsystem of the total device.

   a. Visual scene (i.e., the five CRT color displays)

   b. Situation displays (center of control panels)

   c. Computer aided tutorial (plasma displays)

   d. All are equally important

COMMENTS:____

21. Would you like to see this or similar devices installed in any of the following Navy training facilities: (circle those that apply)

    a. Fleet training centers

    b. SWOS Newport, RI, and Coronado, CA

    c. At the end of the pier

d. In mobile van trainers

COMMENTS: ____

____

____

F. UTILITY

22. Do you have additional suggestions to improve this model trainer?

    a. No

    b. Yes

COMMENTS: ____

____

____

23. My entry level skills and knowledge were adequate to allow me to learn new skills and refresh old ones.

Agree				Disagree
5	4	3	2	1

COMMENTS: ____

____

____

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